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Vol. 28

CHEMICAL AGE

No. 5

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JANUARY, 1920

A Billion Saved.

IN the course of an appeal for support of its campaign to raise \$4,000,000 for its endowment fund, the Massachusetts Institute of Technology makes the statement that over one billion dollars is annually "saved" for the United States as a direct result of the work done by research laboratories in all parts of the United States.

We would be inclined to think that, if anything, the writer of the circular from which this statement was taken erred on the side of conservatism; although a billion is a fairly large amount even in these days when even the financial tyro is no longer staggered by long lines of ciphers, we would be tempted to place the value of research even a little higher.

But be that as it may, the temptation cannot be resisted to quote from this circular of the Institute's further; it is such an admirable plea for scientific research as applied to industry.

"Research is a financial asset," it reads. "If industry is to continue to guarantee prosperity it must keep in direct contact with the vanguard of technical knowledge and skill. Very few people realize the rapidity with which technical progress is being made. The potential value of discoveries made almost daily such as new combinations in alloys, dyes, foods, and so on, is beyond all calculation.

"Today industry no longer has to take whatever is available but decides what characteristics in a metal are needed for her purpose and delegates the research laboratory to provide the material. Every bit of in-

formation gained in research work is utilized, if not for the task in hand or some allied subject, then for one that is entirely foreign.

"An official of a large manufacturing company which carries on a large amount of chemical work reckons its savings through the chemical department at about \$800,000 a year."

And that many American firms have recently come to appreciate the benefit of research in industry is shown by the success attained by the so-called "Technology Plan" whereby corporations by means of retaining fees are enabled to avail themselves of the services of the experts on the M. I. T.'s staff.

Foreign Trade Marks.

THE reported "pirating" on the part of some enterprising Portuguese adventurer, or the trade-marks under which some forty makes of American automobiles are sold, should serve to bring to the attention of American manufacturers the need for registering their trade marks in all foreign markets at the earliest possible opportunity. While it is, indeed, possible in many cases to spike the guns of gentlemen of the type of the Portuguese mentioned above, it is not always possible to restore the right to these trade marks to their original owners. In any case it is always easier and much wiser to forestall any such attempts by protecting trademarks in the first instance against any such mischance.

Pirating of American trade marks has been attempted in many countries. Only a few months ago some ingenious South American attempted to register the words "India Rubber." Fortunately this application was successfully opposed. Had it not been, it would have been impossible for any goods marked "India Rubber" to be sold in the Argentine without the permission of the holder of the patent rights.

The moving picture industry of this country has almost completely lost its right to its distinctive trade marks in foreign countries through the practice prevalent in the motion picture industry of permitting its foreign agents to register the trade marks.

A Credit Clearing House.

AND speaking of foreign trade, perhaps one of the greatest obstacles encountered by American manufacturers ambitious to build up their trade in foreign fields is the truly surprising lack of credit information. While the situation in this direction is not quite so bad as it was formerly there is room for a great deal of improvement. It is this need that makes

the plans of the recently incorporated Bankers Foreign Credit Clearing House so interesting.

This organization is intended to afford a practical means of compiling foreign credit information from every available source and placing it at the disposal of any exporter, provided he is a member of the organization.

The Foreign Credit Clearing House we understand has a rapidly growing membership. Its facilities have already been so organized that information is available in regard to firms in several countries and it is hoped that through the assistance of this organization a great many manufacturers who have until the present been prevented entering foreign markets through lack of proper credit information may become exporters.

The Question of Protection.

STILL the battle rages in Congress over the question of adequate protection for the American dye industry. To date it seems that while there is a great degree of unanimity in regard to the need for protection, the unanimity ceases when it comes to a discussion of ways and means. The supporters of the Longworth Bill and the licensing system of controlling imports apparently stand on one side of the fence while their somewhat doctrinaire opponents, who stand for a high protective tariff and an anti-dumping law, hold forth on the other.

Far be it from us to deny that both sides have reasons and very weighty reasons for their convictions: the standing of the witnesses and the cogency of the arguments they have advanced in support of their respective causes are sufficient justification for such an acknowledgment. But it must be kept in mind that after all both parties are agreed so far as fundamentals are concerned and an agreement in regard to ways and means of attaining the measure of protection sought for the dye industries of this country should not be impossible to reach. If both parties to the debate now raging could be induced to keep their main purpose clearly in mind—the protection of the American dye industry—at all times, to the exclusion of purposes of lesser importance, perhaps it would not be so difficult to find a solution.

While it must be acknowledged that the question under discussion possesses implications that render a decision peculiarly difficult, the fundamental importance of the dye industries in this country, both in times of peace and in times of war, makes it imperative in the interests of the future welfare of our country, that neither questions of policy nor questions of precedent should be allowed to interfere. What measure of protection is to be accorded the American dye industries should be decided after a careful and unprejudiced consideration first, of the nature of the dye industries themselves, and second, of the needs of the industries dependent upon them. That this

consideration should be based upon the assumption that American dyes should supply American needs as far as possible goes without saying. But it must be insisted that even this wholly laudable assumption should not be allowed to interfere too much with the means afforded American users of dyes to obtain dyes.

After all the present shortage of certain dyes and dyestuffs is temporary. Within a few months America will be able to produce, if all goes well, the dyes she now so badly needs. The importation of German products is necessary so long as we are unable to produce the dyes we need ourselves.

And that is why we are inclined to believe that the provisions of the Longworth Bill should be made law: we believe that in addition to doing all that a high tariff and an anti-dumping law can do in the direction of protecting the dye industry it also provides the machinery for the temporary rationing of the textile industry.

The Scarcity of Dyes.

THE scarcity of dyes brought about by the stoppage of German supplies was largely responsible for the increase in the consumption of dyestuffs obtained from vegetable products. As a result of this increased consumption there was a distinct revival of the cultivation of the plants from which these dyestuffs were obtained and a consequent increase in the volume of vegetable dyes produced. Like vegetable indigo they had been driven from the market by the low-priced German synthetic dyes and it needed an exceptional economic situation to bring them back.

Among the vegetable dyestuffs which again came into use during the course of the war were logwood, fustic and Indian indigo. The war-time demand so far as this country is concerned continues, and there is seldom these days an oversupply of the more commonly used vegetable dyestuffs in our markets. Indigo, it is true, is not exceptionally active these days, but then there is no large supply obtainable. Sumac used by tanners is also scarce. The American product is not rated as high as that obtained from Sicily and therefore cannot be substituted.

The war has brought many changes in the world of industry but none more striking than this reversion to the dyestuffs of the ancients.

Foreign Trade Credit.

IN selling goods to business houses in other countries it is in most cases necessary to extend long time credit. At the present time the question of credit is of supreme importance on account of the financial stringency produced by the war. Some of the republics of South America, the devastated portions of Europe and many parts of the Orient have been literally stranded so far as finances are concerned and are now badly in need of supplies of all kinds. While most of

these countries are wealthy enough in natural resources to make eventual payment of their obligations sure, immediate payment is out of the question. Hence the need for the extension of greater credit facilities than heretofore.

Great Britain has already come to a full appreciation of the need for the extension of long term credits to foreign purchasers and the English Board of Trade has arranged to guarantee credits to the extent of £20,000,000,000 and has provided that the terms of any credit thus guaranteed may extend as long as three years, although the charges for the guarantee will be on a rising scale in order to induce early liquidation.

Two steps aimed in the same direction have recently been taken in the United States, the one the passage by the Senate of the so-called Edge bill, and the other the announcement on the part of the War Finance Corporation that it was prepared to extend foreign trade credits to the extent of \$17,000,000. While the importance of the passage of the Edge bill cannot well be overestimated, the plans of the War Finance Corporation, when ranged alongside the extensive plans of the British Board of Trade, seem more or less inadequate. The agitation for some far reaching plan for financing exports must continue until at least a measure of success is attained. The instrument for the distribution of credit has been provided in the Edge bill. It now remains to be seen whether it will be used to the fullest possible extent.

As the New York Times recently pointed out in commenting on this very Edge bill, we are the world's greatest foreign traders almost against our wills, by force of circumstances which will not await our leisure to garner our profits and discharge our duty. Now or never is the motto which the corporations formed under the Edge bill should hang in their offices if they are to live up to their opportunities.

What Is Foreign Exchange?

BEFORE the war not one man in ten thousand had heard of foreign exchange, even in London, the financial center of the world, whereas to day it is a subject of general discussion and conversation.

Our newspapers devote columns to the violent break in the price of stocks and bonds, cotton, oats, corn and other commodities, because the pound sterling has reached a new low record of \$3.68.

Excluding technicalities, foreign exchange is merely the changing of the money of one country into that of another for the purpose of securing payment for goods bought or sold. Our own dollars are passed from hand to hand to pay for our daily needs of goods and services, because by general consent we have agreed that the standard unit of value in our country shall be the dollar, but our dollars will not be acceptable to people living

in other countries any more than their money would be acceptable to us.

Consequently, whoever gets the foreign money has to find some one who wants it before he can change it into his own. Rather than spend the time and effort in locating a buyer for it he sells it to his bank, who can more easily get in touch with a buyer somewhere or other, and to whom he pays a small commission, which is expressed in the difference between their selling price and buying price.

Before the war the difference between these two prices was so small that, year in and year out, no one but financiers ever had to think very seriously about what the rate of exchange might be on any given date for the reason that if ever the supply exceeded the demand to a very great extent (or vice versa) gold was shipped from the debtor country to settle the balance. As one of the results of the war this is impossible nowadays, hence the violent fluctuations in the rates of exchange. The war occasioned a greatly increased demand for goods, and at the same time reduced the number of people who could produce them; consequently those in the fortunate possession of the things needed immediately began to ask more money for them, and as nearly all purchasers were government controlled it was the easiest of all things for the governments to supply the needed money—by what is known as "inflation." Here was the beginning of a vicious circle:—

1. Shortage of goods.
2. High prices.
3. Shortage of money.
4. Increase of money.
5. No increase of goods.
6. Higher prices.
7. Need of more money.
8. Printing of more money.
9. Still higher prices.

and so on in an almost endless circle, limited only by the sanity of the ministers in control of the different Government finances.

It will be seen, therefore, that in order to understand foreign exchange even slightly, it is essential to know exactly what money really is.

It is well known that money today is merely a convenient means by which we exchange what we have for what we need. In very early times, we had no needs that we could not satisfy by the expenditure of our own effort; consequently no money was used, or in existence. At a later period, the precious metals (gold and silver) became the popular form of money, and still later paper money, which was a certificate for gold (inasmuch as it could be and would be paid in gold, either at the banks, or at the government treasuries).

So long as this condition continued, Foreign Exchange could not fluctuate in value to an extent

greater than the cost of shipping gold from one country to another, but when the different countries had an increased supply of paper money alone, or whether they had also an excess of valuable commodities large enough to make their increased supply of paper money worth its full face value in foreign countries.

So long as a country is self-supporting, increasing the quantity of money in circulation only has the effect of making living costs higher, but when one country is partly dependent on its neighbors, if its exports do not equal its imports (and by this I mean the exports and imports for which settlement is made in cash) the value of its money in foreign countries is either going to be quoted at a premium or at a discount.

As an illustration of this we may compare the U. S. A. and Canada, both of whose money is the dollar, which theoretically is supposed to be of equal value.

The U. S. A. has sold so much more merchandise for cash than she has bought, that with the exception of very few countries (to which she is shipping gold and silver to adjust the balance), her dollar is quoted at a premium almost everywhere.

A very similar condition exists with Canada, excepting in her relations with the U. S. A. where her dollar is quoted at a discount, and the reason for this is not that Canada is insolvent, but that compared with the United States, she has sold more goods on credit than she can afford to do, and that when she has to pay the United States for goods bought, there are not sufficient goods sold to the United States to meet them, hence the United States dollar immediately becomes worth a premium in Canada.

CANADA'S trade with England shows just the reverse of this condition, hence Sterling exchange can be bought at a discount of from 75 cents to \$1.00 per one pound sterling.

During the past year New York exchange has gone up from 2 per cent. premium to 11 per cent. premium and the pound sterling has gone down from \$4.86 to \$4.10, and as a consequence everybody in Canada is asking himself any or all of these questions:

1. How much lower can the pound go?
2. Has the pound reached bottom and will it soon improve?
3. How much higher can New York exchange go?
4. When will the premium on New York exchange come down?

Answering these questions fully would occupy a large volume, but looking facts in the face as they are today, and disregarding the suggestions and promises of what may be done until something has really started to be done, we can safely say:

1. That the pound sterling can and probably will go very much below its present price.

2. The pound has not reached bottom yet, and it should improve in value when the importation of such necessities as cotton and wheat has been reduced, and when the export of the manufactured goods has assumed greater volume.

3. New York exchange can go very much higher indeed, and in all probability will do so.

4. The premium on New York exchange will not come down until such time as Canada learns to do without those things she does not produce herself, or produces and sells such an excess of other things which other people want, as to provide herself with the necessary funds to pay for foreign goods.

With such conditions existing, the rest of the world cannot afford to borrow in the United States, so that it is forced to wait until such time as conditions improve theirs.

The first step will be the ratification of the Peace Treaty by the United States Senate, and until this has been done so one can reasonably anticipate better conditions for foreign exchange.

From the foregoing, it can be seen that the exchange situation during 1920 will need the most careful watching, and it is safe to predict that many people engaged in the import or export of goods will suffer severe losses if they do not make it an inviolable rule to secure the rate of exchange on their foreign money at the same time as they agree on the price at which they are going to settle for their goods.

Fifty years ago this was done generally throughout the world. Later laxness crept in and became more or less prevalent until today we have all had to learn our old lessons all over again.

TRUE RESEARCH.

"True research must be intentional and intensive. We must really seek if we would find. We must have imagination, but we must have more than that. There must be the foundation of sound education, and the ability to extend it to embrace new and unexpected knowledge and apply this in turn as we progress upward.

"The future of the world, therefore, depends in a very large degree on the teacher in the school and on the professor in the college. They have an opportunity to mold the world, which many of them thoroughly appreciate.

—Dr. William H. Nichols.

Engineering and Chemical Plants

American Chemical Manufacturers in Many Cases Fail to Take Advantage of Labor Saving Devices and Methods Which Enable Other Industries to Keep Down Overhead and Increase Their Production. Designers of Chemical Plants Should Be Engineers as Well as Chemists.

By A. E. MARSHALL*

THE war-time demand for the products of the chemical industry has of necessity resulted in improvements in chemical engineering practice during the last three years. The inability of the factories in existence at the outbreak of the war to cope with war requirements was responsible for the erection, in this country and in England, of plants designed to produce large tonnage outputs of specified finished materials.

As the desired capacity was known in advance and as the product was definite the designers of these plants had opportunities in arrangement of units which are lacking to a certain extent in the design of factories which have an indefinite future capacity and which necessarily will have to be extended at a later date to take care of new products and by-products.

An inspection of a number of the war-time American factories, and six weeks spent in the English factories during the early summer of this year, has resulted in a conclusion that full advantage was not taken of routing of operations and of labor saving devices which in other industries had reached advanced states of development.

The imperative need for production and the necessity of adapting equipment available during the building of the plants has to be taken into account, and a full knowledge of the difficulties in securing prompt supplies of adequate machinery would doubtless modify in some measure conclusions based only on a study of the completed plants.

Even with such allowance, a survey of the latest development of chemical engineering leaves a sufficient reason for the suggestion that the chemical engineer should broaden his lines of study from the limited one of the purely chemical field to the wider viewpoint of engineering work and operation, in other industries which present problems analogous to the manufacture of chemicals.

The chemical engineer, or the chemical plant executive, is prone to believe that his manufacturing problems are peculiar not only to the chemical industry, but even to his specific branch of the industry, whereas other industries have had similar problems and have reached solutions of these problems which are capable of adaptation to the needs of the chemical factory.

In the past the average chemical plant has started out as a producer of one or of several standard

chemical products, and with the development of the business new but usually inter-related products have been added to the factory output. Invariably the original design was a complete unit so that even an increase in the output of the original products necessitated that addition of separate complete units without the possibility of affecting economies through the use of labor-saving devices applicable only to tonnage movements. When extensions through multiplication of products became necessary the situation was much worse, as the new additions had to be located externally to the original plant unit, and the conveyance of materials produced in the original plant to the new units in which they were to be utilized was necessarily reduced to primitive forms of transportation. There are few industries today other than chemical manufacture which present the anachronism of linking up the travel of the semi-finished product of one operation to its final point of utilization by manual means.

A generation of this nature must of course be qualified by exceptions in the case of plants designed to produce large tonnages of the low-priced chemical staples, or, as they are more generally termed, "Heavy Chemicals." Such factories invariably have labor-saving tonnage movement devices, although they are not always in the forward state of development of the means used in other industries.

This difference in chemical factories is clearly evident in comparing the facilities for moving raw and finished materials in say a modern large tonnage ammonia-soda plant, and a plant producing six or eight products by stages. The soda plant will move its materials progressively with mechanisms which require the smallest amount of human labor, whereas the average several product factory makes each separate movement discontinuous instead of following the easily possible lines of regulated progression. Between the various inter-related units of a several-product chemical factory there is frequently a bottle-neck—of transportation of materials.

A study of what has been accomplished in the automobile industry in the way of linking up producing departments so that a constant output of finished automobiles is obtained, should open up to the chemical engineer a new vista of possibilities. The South furnishes through its fertilizer industry excellent examples of discontinuous work.

A fertilizer plant can be as well ordered in its progressive stages of manufacture as an automobile plant, but the majority of the fertilizer factories

*Paper read before American Institute of Chemical Engineers.

move their entire output at least once and sometimes twice, during the stages of manufacture, by hand labor in buggies. Labor in the South was once cheap, and the incentive to the use of labor-saving devices and the proper layout and routing of departments was lacking. These conditions have changed with apparently no chance of return, and so the fertilizer manufacturer and the chemical engineer specializing in fertilized plant design will be forced to build new plants in which economies in labor are possible.

This brings up the point of the original design of chemical plants and the necessity of designing with an eye to the future. Some chemical plants built within the last five years will find it difficult to make extensions which permit of a lowered cost of production or even a cost equal to the original plant, for reasons such as lack of strength in the building structure preventing the employment of mono-rail cranes or similar mechanisms to convey supplies of raw materials moving from the original storage bins or piles to the new extensions. Time can more profitably be spent in designing the present to suit the future than in trying to add in the future to a completed unit which has no outlets for expansion.

This statement made in the early part of this paper that other industries which are just finding their way into the chemical field or which are still awaiting proper recognition.

As a preliminary, there are some useful guide posts on the road along which the industry has passed.

Equipment Progress.

Take the Chemical Catalog which is issued under the auspices of this Institute and compare the mechanical and labor-saving devices shown in the first volume (1916) with the much greater variety in the present (1919) volume. The manufacturers are not listing plant equipment in 1919 that was not in existence in 1916, but rather they are listing equipment which in 1916 was used only in other industries. Compare also the advertising pages of the chemical journals, say, from 1912 to the present time, and note the introduction into chemical advertising of filters which had found extensive use in the metallurgical field, of grinding machinery primarily developed for metallurgical plants and cement mills, belt conveyors, mono-rail cranes, grab buckets and other mechanical devices for handling materials which were introduced into chemical manufacturing processes after they had become standard parts for other industries. And today other industries have in use types of equipment which would solve many of the problems we consider solely as chemical engineering problems.

First there is the matter of moving materials through the cycle of the plant operation.

The movement, at the lowest possible cost, of

large tonnages of raw and finished materials has assumed great importance in industries where there is close price competition. The progress of chemical manufacture with the consequent increase in size of chemical plants will make this feature of plant design of vital interest to the owners of these plants. Water-front factories bringing in their raw material by steamer will be forced to adopt unloading methods equivalent to those used in the iron and steel industry. Factories in the interior will have to be arranged so that railroad cars can be placed directly at the discharging or loading points so that double handling of materials is avoided. The linkage of materials, moving from one part of the plant to another, and referred to in the earlier part of this paper, will have to be changed from manual to mechanical means, and the plant units so arranged that the intervals to be bridged in the movement occupy the shortest possible distance while still permitting the future growth of the units.

All of these improvements in handling have become part of the routine design of other industries, and the chemical engineer, by extending his observation outside of the chemical field can usually find an operation, with characteristics similar to the project he is interested in, which has developed handling facilities adaptable to the needs of the chemical plant.

In the case of the chemical engineer concerned in the layout of a furnacing operation, a study of the modern central station power plant will often suggest improvements over existing chemical practice. There are many chemical plants which use as much coal under furnaces each day as a large power plant does under its boilers. The power plant is in the business of utilizing coal for profit, so it has, in the movement of coal, displaced manual labor by mechanical methods. The power plant unloads its coal into storage with grab buckets operated from gantry or overhead cranes, and has developed other forms of mechanical equipment to convey the coal from storage to the boiler room and to the individual mechanical stokers. The ashes from the boilers is gathered either by drag conveyors, pressure or suction devices and is delivered to hoppers which discharge direct into cars or ash scows.

The arrangement of the average chemical plant carrying on furnacing operations effectually prevents the use of a complete scheme of mechanically handling coal and ashes, as the furnaces have grown Topsy-like in various parts of the factory, and even the coal storage itself has usually to be placed remote from the the furnaces.

The control of combustion, which is essentially a chemical problem, has progressed to a greater extent in power plants than in chemical factories, and it is the unusual chemical factory which has a complete equipment of CO₂ recorders, pyrometers, and draft-gauges on its furnaces.

Further suggestions along these same lines are afforded by the study of flow sheets of metallurgical works. The flow sheet of a modern smelter with its allied leaching and flotation plants represents a development in low cost movement far ahead of the average large chemical plant although the equipment used in the smelter is in many instances equally serviceable in chemical factories. Leaching by counter-current decantation in its present efficient state is a development due to metallurgical engineers who were faced with the problem of economically treating low-grade ores. The same apparatus will serve the chemical manufacturer for the production of solutions or an insoluble precipitate through the inter-action of a solid and a solvent or solution. The various types of classifier have made closed circuit grinding a possibility, and the chemical manufacturer can adopt from the metallurgist without change, a method of operation which gives a continuous finely ground product without a distinct intermediate separation.

Brief mention has already been made of filters used in metallurgical work and of their adoption in chemical processes. The continuous removal of a solid product from a waste liquid or the continuous separation of a solution from a waste solid in suspension means a great reduction in cost as compared to the use of intermittent plate and frame presses.

The various processes of illuminating gas manufacture afford useful study, and some interesting developments should result from the adoption by the chemical industry of gas washers of the Feld type. Feld type washers have provided the gas engineer with a compact mechanism which gives an intimate contact between the gas and an absorbing or scrubbing liquid while the arrangement of the washer permits the liquid to reach a high concentration in solid particles without danger of stoppage. A cast iron washer of this type would, as an example, remove chlorine, using caustic soda solution as the liquid, from the exit of a chlorinating operation, and going for the moment outside the strictly chemical field, it might serve in an absorption method of recovering gasoline from natural gas, in place of the present expensive compressor plants.

Made of acid-proof materials, and somewhat modified in arrangement, this same type of washer might be used to replace one of the unsatisfactory details in a sulphuric acid chamber plant—the Gay-Lussac tower.

As an illustration of the satisfactory use of mechanism developed in other industries, an instance at the factory with which the writer is connected, may be cited.

One portion of the plant operation depends on the continuous supply of large tonnage of raw material. Prior to 1918 this raw material had always

been delivered at the plant in steamers—and a complete scheme of mechanical unloading has been installed and had given excellent results.

The shipping strike and the shortage of steamers in 1918 made it necessary to change over from steamer to box car conveyance, and as the raw material was used at the rate of 600 tons a day it meant either excessive hand labor in unloading the cars or the adoption of some mechanical unloading device.

A review of practice in the chemical industry did not afford any suggestions, neither did the usual engineering catalogues or trade publications refer to a machine which would solve the problem.

Consideration of materials that were moved in tonnages in box cars led to an investigation of grain industry, and it was found that the grain elevators had been using a mechanical box car unloading device for at least 10 years and that this device could be adapted without change to the conditions we had to meet.

The grain unloaders were installed, and as a result of their use the movement of incoming raw material kept pace with the consumption. The congestion of plant facilities through the inevitable delays which would have occurred under hand unloading conditions were avoided, and, most important of all, the cost of putting the material into the plant was kept down to a reasonable figure.

In bringing this paper to an end, the examples which have been selected do not exhaust the possibilities of comparison, but they will serve the writer's purpose if they are accepted as evidence in support of the conclusions which were advanced in the first paragraphs—that the chemical engineer can study to his advantage engineering progress in other lines of industry.

Export Standards.

In a recent statement the United States Alkali Exporters' Association says that considerable progress has been made in the matter of standardizing goods and packages for export. The statement concludes: "The association welcomes to its membership any reputable manufacturer of soda ash or caustic soda whose product will come up to the specifications set by the association and whose package is properly designed to meet the hard usage of sea tonnage. The members of the association are as follows: The Columbia Chemical Co., Diamond Alkali Co., Hooker Electrochemical Co., Mathieson Alkali Works, Inc., Michigan Alkali Co., Pennsylvania Salt Manufacturing Co., Republic Chemical Co., Solvay Process Co., Warner-Klipstein Chemical Co. The officials of the association are: President, Eli Winkler; vice-president, H. G. Carrell; secretary and treasurer, H. M. Hooker; manager, E. V. Finch. Export orders are accepted either by the association or by any of its members, and the results for the first five months of its operation have been eminently satisfactory. The industry has maintained a good volume of exports and believes a good start has been made in establishing firm and permanent connections abroad."

Explosion Process of Sulphate Recovery

By New Process the Alkali May Be Recovered from the Black Liquor of the So-Called Sulphate Process Without Using any Extraneous Fuel. After Many Years of Experimentation the New Process Has Been Installed in the La Tuque Mills of the Brown Co.

By HUGH K. MOORE

Technical Superintendent, the Brown Company, Berlin, N. H., and member National Research Council.

At our Buffalo meeting in 1917 I read before this Institute a paper entitled "Chemical Engineering Aspect of Renovating a Sulphide Mill." In this paper I mentioned a new method of recovering alkali from the black liquor of the so-called sulphate process. In the new method as outlined in the above paper I mentioned some of the inherent difficulties. I showed that, while it was theoretically possible to evaporate the 50% liquor to dryness, ignite and burn it without the addition of extraneous fuel, it was not practical at that time because no method had been evolved by which the liquor could be subdivided to that minuteness necessary for this operation to take place.

If you recall, this liquor was being atomized by a blast of high pressure air with atomizing nozzles developed to a state of high efficiency by years of constant experimenting, and that, owing to the velocity imparted to it by the high pressure air, it was traveling like the shot out of a gun. The landing place for this liquor was only some feet away, and yet 50% of it had to be evaporated and the remainder ignited in this infinitesimally small part of a second.

It was also brought out that, without extraneous sources of heat, this liquor was not evaporated and ignited, but that it landed on the fire, plastering it over and putting it out. It was also brought out that it was not lack of sufficient heat in the furnace, but that there was no means of transmitting the required heat to the flying particles at such a rate as to evaporate the water and ignite the remainder while in transit.

We showed how we made use of Stefan's Law which, in brief, is that the heat radiated from one black body to another is as the difference of the fourth powers of the absolute temperatures. This

may be expressed as follows:
$$E = K \frac{T_2^4 - T_1^4}{T_2 - T_1}$$

where E is the total energy radiated, T_2 and T_1 being absolute temperatures, T_2 being the higher.

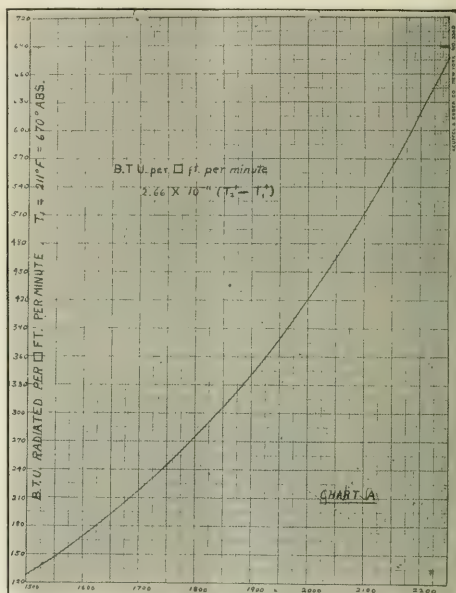
Putting this into tangible form we get this formula: B. T. U. radiated per minute $= 2.66 \times 10^{-11} (T_2^4 - T_1^4)$

Table 1 shows the B. T. U. radiated per sq. ft. per minute at different temperatures according to Stefan's Law.

Table 2. shows B. T. U. radiated per sq. ft. from

black bodies at different temperatures to bodies at 211° F.

Chart A shows this in graphical form.



It will be remembered that we tried crude oil, but found that with oil we had the coldest zone where we needed the hottest fire. We tried powdered coal, but found that in addition to the usual difficulties the impurities in the coal not only used up our soda, but also prevented rapid settling in our causticizing tanks. We finally adopted producer gas of such a quality as should contain the maximum amount of illuminants. These illuminants radiated heat to the flying particles of black liquor.

At this time I did not attempt to show the square feet of radiating surface in these particles and consequently did not go into the subject as to the magnitude of effect of the radiant heat. We had certain data which we did not care to make public first, because they were only in approximation, and secondly, because we were conducting further experiments and did not want to draw other people's attention to these investigations.

Our experiments have been crowned with success, though we have not as yet carried them to their logical conclusion. The process based on these ex-

*Paper read before American Institute of Chemical Engineers.

Table 1.

Heat radiated per sq. ft. per min. Stefan's Law for Black Bodies. English units

$$K = 2.66 \times 10^{-11} \quad E. T. U. = K (T_2^4 - T_1^4) \text{ per min.}$$

$T_1 = 500^\circ \text{ abs.}$		$T_1 = 600^\circ \text{ abs.}$		$T_1 = 700^\circ \text{ abs.}$		$T_1 = 800^\circ \text{ abs.}$		$T_1 = 900^\circ \text{ abs.}$		$T_1 = 1000^\circ \text{ abs.}$		$T_1 = 1100^\circ \text{ abs.}$	
T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.
800	9.2	800	7.4	800	4.5	800		800		800		800	
900	15.8	900	14.0	900	10.5	900	6.5	900	9.0	900		900	
1000	24.9	1000	23.1	1000	20.2	1000	15.5	1000	9.15	1000		1000	
1100	36.2	1100	35.5	1100	31.3	1100	28.7	1100	21.5	1100		1100	
1200	55.5	1200	51.7	1200	48.8	1200	44.5	1200	37.8	1200	28.6	1100	
1300	73.9	1300	72.1	1300	69.7	1300	64.7	1300	58.2	1300	49.0	1200	16.3
1400	100.4	1400	98.8	1400	94.7	1400	91.2	1400	84.7	1400	75.6	1300	36.6
1500	133.0	1500	131.3	1500	127.7	1500	123.8	1500	117.2	1500	107.4	1400	63.2
1600	172.5	1600	171.0	1600	167.9	1600	163.0	1600	156.8	1600	147.5	1500	95.7
1700	220.5	1700	216.0	1700	215.1	1700	211.2	1700	204.6	1700	195.4	1600	135.4
1800	278.0	1800	276.0	1800	273.0	1800	268.0	1800	261.9	1800	252.5	1700	183.1
1900	342.0	1900	340.2	1900	336.8	1900	332.8	1900	326.2	1900	317.1	1800	240.4
2000	424.0	2000	422.0	2000	419.0	2000	414.0	2000	408.2	2000	399.0	1900	294.9
2100	515.8	2100	514.0	2100	510.4	2100	506.5	2100	499.9	2100	490.8	2000	366.8
2200	621.5	2200	619.5	2200	616.0	2200	612.0	2200	605.6	2200	596.4	2100	479.4

Table II.

Heat Radiated per sq. ft. per min. Stefan's Law for Black Bodies. English Units

$$K = 2.66 \times 10^{-11} \quad E. T. U. = K (T_2^4 - T_1^4) \text{ per min.}$$

$$T_1 = 670 \text{ abs} = 211^\circ \text{ F}$$

$T_1 = 670 \text{ abs}$		$T_1 = 670 \text{ abs}$		$T_1 = 670 \text{ abs}$		$T_1 = 670 \text{ abs}$		$T_1 = 670 \text{ abs}$	
T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.	T_2	B.T.U.
800	5.5	1100	33.6	1400	96.7	1700	216.7	2000	420.3
900	12.1	1200	49.9	1500	129.3	1800	273.8	2100	511.8
1000	21.2	1300	70.2	1600	172.9	1900	338.3	2200	617.6

periments has superseded the process described in the previous paper and is being developed to its logical conclusion as fast as we can get apparatus and equipment. In this new development we operate without using any extraneous fuel and net a large boiler horse power. After having spent much money and many years experimenting on atomizers for this liquid we finally decided that any further experiments along this line were a waste of time and money and so discontinued them. We started a new series of experiments, however, the effect of which was to disrupt these fine particles by a force contained therein and thus not only expose more

surface to the hot furnace gases, but also form more surface which, if ignited, would radiate more heat to other particles in transit which had not reached the dehydrated stage.

Of course the cheapest source of explosion is in steam.

Table 3 gives data from Marks & Davis Steam Tables giving the volume of steam and pressures at different temperatures, and Chart B shows these data in graphical form.

If you refer to Chart B, you will observe that at the low pressures that 1 lb. of water occupies many cubic feet when changed to steam. Thus at 249°

Table III

Steam Pressures and Volumes of One Pound of Water at Different Temperatures

Temperature F	Gauge Pressure	Volume in cubic feet	Temperature F	Gauge pressure	Volume in cubic feet
211	.98	27.29	310	63	5.62
220	3.	23.15	320	75	4.91
230	6.	19.39	330	88	4.306
240	10.	16.32	340	104	3.787
250	15.	13.82	350	121	3.342
260	20.	11.76	360	138	2.957
270	27.	10.06	370	158	2.627
280	35.	8.64	380	181	2.340
290	43.	7.46	390	205	2.089
300	52.	6.46	400	232	1.872

F 1 lb. of steam occupies 14 ft. If we consider 27.65 cu. in. to the pound we have one volume of water expanding to 874 times its original volume. The altitude of La Tuque is about 560 ft. above sea level and the boiling point of water is 211° F. Consequently as the work of which I am going to speak of was done at La Tuque, the figures which are given in this paper refer to an altitude of 560 ft. above sea level with the corresponding boiling point of water of 211° F.

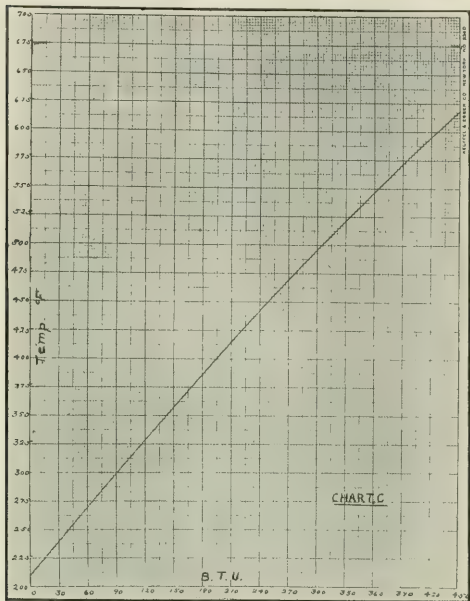


Chart C

Referring again to Chart B it will be seen that 1 lb. of steam at 211° F. occupies 27.29 cu. ft. and consequently occupies 1703 times its original volume.

If now we can heat this liquor sufficiently and maintain pressures higher than those required for the corresponding temperatures, we can then prevent evaporation and yet store energy in the liquor. If now the pressure upon this liquor is released suddenly, we should have an explosion corresponding to the ratio between the steam formed and the liquor left.

In order that we may bring this into concrete form I am going to give now the data I shall use in future calculations.

Black Liquor.

Per cent water	44.7
Per cent total solids	55.3
Specific gravity of dehydrated black liquor, 15°C.	2.029
Specific gravity wet black liquor, 15°C.	1.39
Specific gravity of smelt, 15°C.	2.21
Specific heat dehydrated black liquor, 15°C.	.56
Specific heat of smelt from 0 to 100°C.	.52
B. T. U. in 1 lb. of smelt	525
Quantity of Heat N.	$(2405 + .000019t)t$
Quantity of CO ₂	$(.19 + .00006t)t$
Quantity of O ₂	$(.2104 + .0000187t)t$
Quantity of CO	$(.2405 + .000019t)t$
Quantity of steam	$(.42 + .000103t)t$

Capacity of furnace, clean.....	294 cu. ft.
Capacity of furnace, operating.....	327 cu. ft.
Area of inside furnaces.....	273 sq. ft.

Cubic ft. gas operating conditions going through furnace per min. 55,000.
 Length of time it takes a particle to travel from nozzle to exit of furnace..... .32 second
 Average volume liquor blown in per min.....1.13 cu. ft

The specific heat of the dry liquor is .56 and that of water is of course 1. An explanation of what I mean by explosive ratio may be in order. Thus at 360° F. at a pressure over 138 lbs. per sq. in. we liberate from 1 lb. black liquor 115.8 B. T. U. when the pressure is reduced to a barometer of 29.33 in. mercury. This liberates .1191 lbs. of steam, which in a liquid state occupied 3.29 cu. in.; 1 lb. of black liquor occupies 18.89 cu. in. The difference, 16.60 cu. in., is occupied by the remaining liquor. Now .1191 lbs. of saturated steam at 211° F. occupies 5611 cu. in. and this divided by 16.60 gives 338.1, which is the explosive ratio. The explosive ratio is quotient obtained by dividing the volume of steam formed by the volume of the residual liquor.

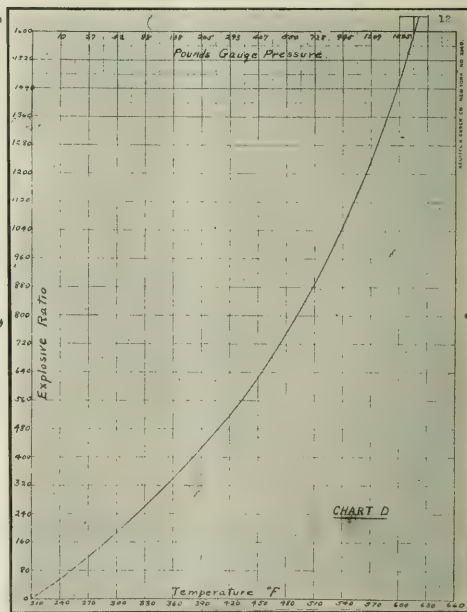


Chart D

It will be observed from a study of Table V and Chart D that the pressure increases at a greater rate than the explosive ratio. But this is a matter which I do not intend to go into in this paper, as we have not yet determined at what point the increased efficiency is counterbalanced by the power and costs of maintaining increased pressures.

The general composition of pulp wood is as follows:

Cellulose	50%
Carbohydrates	16%
Lignin	30%

Table IV

Heat in Hot Water Available for Formation of Steam at 211°F

Temp.	B T U	Temp	B T U	Temp	B T U	Temp	B T U	Temp	B T U	Temp	B T U
211	0	280	70.0	340	142.4	420	216.4	490	214.	560	371.
220	9.1	290	80.3	360	152.9	430	227.2	500	305.	570	387.
230	19.2	300	90.6	370	163.4	440	238.0	510	317.	580	399.
240	29.3	310	100.9	380	173.9	450	249.0	520	328.	590	412.
250	39.4	320	111.2	390	184.5	460	260.0	530	340.	600	425.
260	49.6	330	121.6	400	195.1	470	271.	540	352.	610	
270	58.9	340	132.	410	205.7	480	283.	550	363.	620	

Protein 7%
Resin & Fat 3.3%

If we take out the cellulose the remainder of the wood, viz., that which goes in to the black liquor, has the following composition:

Carbohydrates 32%
Lignin 60%
Protein 1.4%
Resin & Fat 6.6%
Ash in 1.13 cu. ft. 227 lbs.
Analysis of Flue gases CO₂ 15.0%
CO 6%
O₂ 3.3%
N₂ 81.1%
Temp. furnace under running conditions 1950°F.
Temp. of smelt at bottom 1600°F.
Dry black liquor occupies 13.62 cu. in per lb.
Water occupies 27.65 cu. in per lb.
Latent Heat 1 lb. water at 211° 971.3
B. T. U. per lb. of dry black liquor as it enters furnace = 5080 B. T. U..

Table IV based on Marks & Davis Steam Tables, illustrated by Chart C shows the number of B. T. U. available for explosion at 211° F. of 1 lb. of water heated at different temperatures with the pressures maintained above said temperatures according to Chart B.

Once more, even at the risk of being tedious, I want to emphasize that the pressures MUST be maintained according to the temperature, so that not the slightest evaporation can take place.

Chart D shows geographically the explosive ratio of liquor at different temperatures according to Table V.

Now considering the carbohydrates in wood liquor and have a formula of C_nH_{2n}O_n, in which n is 5 or 6, we have this approximate composition:

Carbon 40%) Combined water, 60%
Hydrogen 6.7%) Excess H₂ to H₂O, none
Oxygen 53.3%)

If we assume Klason's formula for liquor, viz., C₃₈H₃₈O₁₁C₄₀O₁₁.2CH₂.O, we get this approximate composition:

Carbon 67.2%) Combined H₂O 30.3%
Hydrogen 5.9%)
Oxygen 26.9%) Excess H₂ to H₂O 22.7%
Total 53%

In the same way we may take the following as

Table V.

Table Showing Explosive Effect of Black Liquor at Different Temperatures.

Basis is 1 lb. Black Liquor, Sp. Ht. = .756

1 lb. black liquor = 19.89 cu. in.

Temp ° F.	B.T.U. in 1 lb. H ₂ O available for steam at 211°F.	B.T.U. Lit-tered 1 lb. Black liquor	Loss due to change of state of steam at 211°F	Cu. in. H ₂ O change at 211°F	Cu. in. 1 lb. Black liquor at explosion at 211°F	Cu. in. of steam from 1 lb. of water at explosion at 211°F	Explosive Ratio	Gauge pressure
211	0.0	0.0	0.0000	0.0000	19.89	0.000	0.00	0.3
220	9.1	9.9	0.0071	0.1250	19.76	0.000	15.68	2.
240	29.3	22.1	0.0226	0.4328	19.46	1.000	55.66	10
260	49.6	37.5	0.0366	1.0680	18.82	1.000	86.70	21
280	70.0	52.9	0.0545	1.8090	17.94	2.000	148.66	34
300	90.6	69.5	0.0705	1.9500	17.04	3.000	218.48	52
320	111.2	84.1	0.0866	2.3940	17.00	4.000	273.32	75
340	132.0	99.9	0.1029	2.8470	17.00	4.000	284.20	100
360	152.9	115.2	0.1191	3.2910	16.60	5.000	338.12	139
380	173.9	131.7	0.1354	4.9430	15.68	6.000	406.20	181
400	195.1	147.9	0.1517	4.2000	15.15	6.000	486.40	225
420	216.4	154.0	0.1580	4.6590	15.23	7.000	521.60	294
440	238.0	160.3	0.1643	5.1240	14.77	8.000	557.60	39
460	260.0	167.0	0.1704	5.5980	14.28	9.000	593.60	51
480	283.0	214.4	0.1764	6.0630	13.79	10.000	629.60	64
500	306.0	231.1	0.2374	6.5280	13.30	11.000	665.60	78
520	328.0	248.5	0.2381	7.0620	12.81	12.000	701.60	95
540	352.0	266.7	0.2381	7.5970	12.31	13.000	737.60	115
560	376.0	284.1	0.2381	8.1320	11.80	14.000	773.60	138
580	399.0	302.4	0.2381	8.6670	11.30	15.000	809.60	155
600	424.0	320.1	0.2381	9.1490	10.78	16.000	845.60	176
620	453.0	343.3	0.2381	9.7520	10.18	17.000	881.60	200

the average composition of protein

Per cent.	
Carbon	55.6%
Hydrogen	9.2%
Oxygen	13.0%
Nitrogen	22.2%
Combined water.....	25%
Excess hydrogen will burn to H ₂ O..	58.3%
Total.....	83.3%

Even if the above is not correct, the error will be negligible on account of the small amount involved.

If we consider the resin of a formula C₁₀H₁₆O we have an approximate composition of

Carbon	79.0%
Hydrogen	10.5%
Oxygen	10.5%
Combined water.....	11.8%
Excess H to water..	82.8%
Total.....	94.6%

Multiplying each by its percentage we get the results shown in Table VI.

It will be seen from the above that the residues from the wood after taking out the cellulose contains 59.11 per cent carbon. From data given we find that we have .269 lbs. of organic matter, and we can also figure from .177 lbs. carbonate that we have .0200 lbs. of carbon therein, which corresponds to .0338 gms. of lignin liquor. Adding this to the organic matter we have .3029 lbs. of organic matter; .59.11% of this gives carbon present from 1 lb. black liquor. 1791 lbs., of which .1591 lbs. goes into the furnace gases, and 0200 lbs. goes into sodium carbonate.

In ascertaining the heat in the liquor we assume that all the oxygen is combined with hydrogen and the residue hydrogen is calculated to burn with oxygen, giving 62000 B. T. U. per lb. of hydrogen burned. The carbon is calculated as giving 14500 B. T. U. per lb. when burned in the furnace. As to the carbon combined with the soda in form of carbonate we cannot give it 14500 B. T. U. per lb., as it combines with the liquor in the digester to form lignin and resin soap, acetates, etc. If we assign .6 of its value, viz., 8700 B. T. U. per lb., I think we shall have all the heat we are entitled to assume that we get from this source. Accordingly the .02 lb. C in Na₂CO₃ would have 174 B. T. U. available as extra heat. If the formula given is

correct for an average sample, our wood lignin (meaning all the wood but the cellulose) should contain 9560 B. T. U. per lb. Let us see if from other sources we can confirm this. This dry black liquor owing to its easy fusibility cannot be burned directly in a calorimeter. A sample was mixed with coal whose calorific value was known. Several determinations gave a value of 5080 B. T. U. per lb. If this value was used in the above tables we should have a total heat in the liquor of 2809 B. T. U. instead of 2806 as given in Table IX.

Table VII from Gottlieb shows the composition of air-dry woods though the B. T. U. per lb. is figured on a bone-dry basis (air-dry woods contain 18% to 20% moisture.)

According to this table if cellulose has 7720 B. T. U. per lb. 1 lb. of lignin (meaning all the constituents of the wood but the cellulose) should have

Table VII.									
Ultimate Analysis of Air Dry Woods. Calorific Value. Bone Dry Wood.									
Kind of wood.	C	H	O	N	S	Calorific Value per lb. Bone Dry Wood			
Oak	50.16	6.07	0.09	45.36	0.37	8316			
Ash	48.10	6.77	0.07	45.21	0.57	8460			
Pine	50.29	6.23	0.06	44.44	0.50	8510			
Maple	49.08	6.11	0.05	44.37	0.57	8591			
Alfalfa	46.09	6.70	0.10	46.17	0.57	8586			
Fir	50.26	1.92	0.01	44.39	0.26	9063			
Pine	50.31	6.20	0.04	45.06	0.37	9153			
Poplar	48.35	6.21	0.06	45.60	1.86	7854			
Willow	48.96	5.96	0.06	44.66	3.37	7926			
Calculated.									

for fir 10406 B. T. U., and 1 lb. of the lignin from pine should have 10586.

I am inclined to think both these values rather high, at least for our woods. Table VIII shows data which we have determined experimentally. According to my observations we get the following results:

The above table is given because the average composition of wood does not apply to our mill at La Tuque. At La Tuque all the logs come from the river on a conveyor and they travel sidewise instead of lengthwise. A trap is arranged by which the large logs are dropped to another conveyor which goes to the Saw Mill. The slabs from the Saw Mill are composed almost entirely of sap wood, and they are used for making pulp after first having the bark removed in the debarking drums.

TABLE VI.

Substance						% Excess H	Total Water of Combustion
Carbohydrates.	.00	12.80	2.14	17.06	1920	.0000	19.20
Lignin	.00	40.50	3.54	16.12	1818	1.51	31.80
Protein	.18	.78	0.13	0.13	.30	.09	1.17
Resin	.00	5.21	5.21	0.69	.78	.61	6.24
Total	.18	59.11	6.50	34.21	38.46	2.21	58.41

In Table IX we give the heat balance of a furnace in operation.

It will be noticed from the above table that the

Table IX.
Heat balance of one unit used in the process.

Kind of fuel	per hour	per lb.
1. Fuel used in the process	914	1.00
" " " " " " " "	375	1.00
" " " " " " " "	1019	1.00
Cellulose (total)	1019	1.00

outgo of heat, viz., 3040 B. T. U. per lb. of liquor, nearly balances the income 3076 B. T. U. of heat, and there has been no allowance made for radiation,

Table IX
Heat balance of one unit used in the process.

B. T. U. of combustion 1500 lbs carbon to CO	2219
+ B. T. U. in 100 lbs carbon in furnace	174
" " " " " " " "	413
" " " " " " " "	1.7
" " " " " " " "	136
" " " " " " " "	50
" " " " " " " "	3096
+ Carbon absorbed in melt	3096

which will be exceedingly small in this case, as all the furnaces but the end ones have no radiation of heat from the side walls, i. e., the side wall of one furnace butt up against the side walls of adjoining furnaces.

In Chart E we show graphically the amount of heat contained in 1 lb. of nitrogen, carbon dioxide, carbon monoxide, oxygen steam as calculated from data given at different temperatures.

The steam curve does not show the latent heat of evaporation any more than do the others. In table X we have the data upon which Chart E is based.

With the foregoing data at hand I will now describe the main elements in the process as now carried out. This process, for lack of a better name, is designated as the Explosion Recovery Process. Before doing so, in order that the difference in the process may be clearly understood, I submit diagrams 1, 2 and 3, illustrating the process which the explosion process had superseded. The process shown in diagrams 1, 2 and 3 had superseded in our mill the older processes, consisting of a Porian evaporator, incinerator, smelting furnace, and dissolving tank as its main constituents. Diagrams 1, 2 and 3 are portions of those in U. S. Patent No. 1,137,780, dated May 4, 1915, and for a detailed description you are referred to this patent. In brief, producer gas comes through main 114, entering furnace through pipe 116; air from 2 to 5 lbs. pressure per sq. inch comes from main 117 and enters furnace through pipe 120. Black liquor enters mixing tank 121, where it is mixed with salt-cake, and enters furnace through pipe spout 127, from which it is atomized by air at high pressure through slot 128. The smelted liquor runs from spout 106 to dissolving tank 107, while the

products of combustion pass under and through boiler 109, through from 112 and precipitator 113 to the stack. In the patent mentioned 113 is called a washer, but since this patent was taken out we installed a Cottrell Precipitator, manufactured by the Western Precipitation Company.

In diagram No. 3, 140 is a burner atomizing oil. This process preceded the one shown in diagrams 1 and 2. It will be observed from the above diagrams that the gas or oil is below the air supply and thus causes a reducing atmosphere.

In the new process or explosion process as we call it we use no extraneous fuel.

Diagram 4 shows the main principles of the new process. I shall describe this as briefly as possible. For those requiring a more detailed description I refer them to the above patent.

In the explosion process, diagram 4, the black liquor,

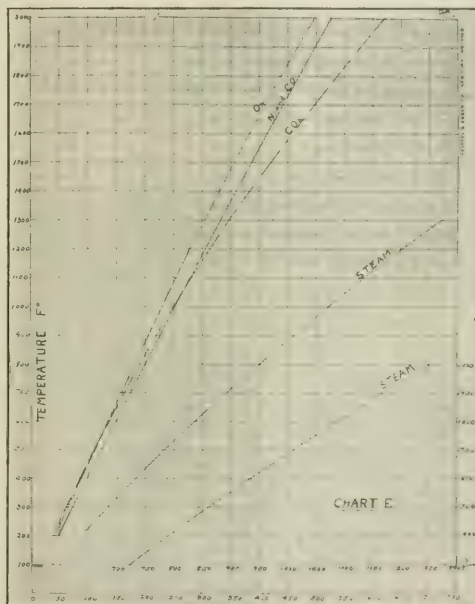


Chart E

having been mixed with salt-cake in a mixer tank, goes through pipe 8, pump 9 through pipe 10, tee 11, pump 12, heater coil 14, pipe 16 and manifold 20. From manifold 200 part of the liquor goes to the furnace through pipe 19, terminating in nozzle. The remainder of the liquor goes through pipe 20 to pump 21, pipe 22, check valve 221, tee 11, pump 12, and so on through the cycle. In practice pump 9, 12, and 21 are combined in a 4 stage single pump in which the first two stages take the place of pump 9, while the third stage takes the place of pump 21 and the fourth stage the place of pump 12. But it is shown as above for clearness.

Coil 14 is a spiral coil and may be enclosed in a

tank as shown or in another spiral coil. Parenthetically I will state that the heat conductivity of a spiral coil per square ft. per degree difference is greater than that of the straight pipe in the familiar double-pipe cooler for the same velocities. But this is a subject I cannot go into here, but I may in the near future devote a paper to this subject.

In the tank or surrounding coil is the heating medium, steam is suitable for temperature up to 330° F. and hot oil for the higher temperatures. The air for combustion enters pipe 37 at from 2 to 5 lbs. pressure and digs into pile 29, which we endeavor to accumulate. The gases go under boiler 27, which serves the purpose of condensing the hot alkali and recovering heat from the hot gases. The gases then pass to the precipitator 33 which removes those particles still held in suspension. It is the intention that pile 29 shall slump forward, thus letting the molten alkali liquor run through the char on its way to the spout 35 and dissolving tank 36.

The reduction of sodium sulphate to sodium sulphide is an endothermic reaction. The extra heat required for it is radiated from above to the char and thence conducted to the molten liquor running there through. Now it will be seen from the foregoing that the hotter the liquor is heated in the heater the less water has to be evaporated in the furnace and the greater the explosion effect.

Now let us see what the results of this explosion gives us in actual practice.

We first tried to find the sizes of the particles of

black liquor resulting from explosion. We passed several slides through the atomized liquor and examined them under the microscope. The results are illuminating as showing the effect of the explosion. The results here Photograph No. 1 shows an average field of black liquor specks. This at a magnification of 10 does not show the smaller specks. This photograph was taken from black liquor exploded into the atmosphere at about 70° F. It is an indication only for these were taken from liquor atomized into the cold atmosphere and in all probability only represents a small portion of the disruption which takes place in a hot furnace. Taking an average field we find the sizes of particles range in diameter from .032 mm. to 2.16 mm., and with thickness from .00447 mm. to .094 mm.

Table XI shows the sizes of black liquor particles obtained by exploding the black liquor into the atmosphere. This was done with an explosion ratio of 76, which is very low indeed.

From the above it will be seen that the thicknesses vary to a considerable extent even with the same diameters. In order to get at the number and sizes of specks in a given field a photograph was taken in which 1 mm. was represented as 3.5 centimeters. The sizes were classified as follows:

Size a nearer to .037 mm diam. than to other sizes
Size b nearer to .077 mm. diam. than to other sizes
Size c nearer to .118 mm diam. than to other sizes
Size d nearer to .143 mm diam. than to other sizes
Size e nearer to .233 mm diam. than to other sizes
Size f nearer to .333 mm diam. than to other sizes
Size g nearer to .400 mm diam. than to other sizes

Table X To Accompany Curve Chart E.

Heat Contained in Different Cases at Different Temperatures.

Calculated According to the Following Formulas.

$$\begin{aligned} (.2405 + .0000119t)t &= \text{B. T. U. for 1 lb. N} \\ (.19 + .00006t)t &= \text{B. T. U. for CO}_2 \\ (.2104 + .0000187t)t &= \text{B. T. U. for 1 lb O} \\ (.2405 + .0000119t)t &= \text{B. T. U. for 1 lb CO} \\ (.42 + .000103t)t &= \text{B. T. U. for 1 lb steam} \end{aligned}$$

Temp. F.	H	CO ₂	O	CO	H ₂ O Steam
200	40.5	38.25	42.8	48.5	212°F. 93.6
400	98.1	85.6	87.1	98.1	164.5
600	148.6	135.6	132.9	148.6	289.1
800	200.0	190.4	180.3	200.0	401.9
1000	252.4	250.0	229.1	252.4	523.0
1200	305.6	314.6	279.4	305.6	652.4
1400	359.9	383.6	331.1	359.9	790.0
1600	415.3	457.6	384.4	415.3	935.4
1800	470.3	536.4	439.2	470.3	1090.0
2000	527.6	620.0	496.0	527.6	1252.0

and circles in different colored inks were drawn about each speck on the photograph according to which class the observer placed it in.

Table XII shows an analysis of one of these fields. This table shows the flat diameter, the flat thickness calculated weight in mgms. and volume in millimeters of speck given 6x diameter of sphere of equal volume in mm. surface of sphere in mm² with the number of particles of each in an average field, total wt. of particles in field and total surface in mm. Now if a furnace burns 1.13 cu. ft. of

liquid by other bodies. The above is assuming that the temperature of the walls are 1950° F., and that the temperature of the black liquor particles were also at 1950° F. As a matter of fact we have reason to believe that the burning liquor particles have a temperature of from 2000° perhaps over 2150°, in which case they would have the power of radiating about twice as much heat as above given. As a matter of fact, the heat required for the evaporation of the water is only 19.7 B. T. U., so that we see that even at the lower temperatures we have sufficient heating surface to effectually dry the incoming liquor. As the smaller particles of this liquor take fire only a few inches from the nozzle we can imagine that we have them interspersed among larger particles which are constantly taking fire, and that nearly all the surfaces are radiating effectively heat to other parts of the liquor. In this case we do not have to consider the specific heat of the particles as it is evident that if they contain nearly all the total heat entering the furnace, that they can readily spare this small amount of heat without lowering the temperature below 1950° F., the temperature of the whole furnace. It may be argued that as they burn they

liquor a minute and if the volume of the surface is changed every .32 second, then we can calculate the approximate number of specks, their total radiating surface and the amount of heat radiated from each. It might be of interest to know that this liquor atomized into the cold air would have specks in suspension in a space of 294 cu. ft. and have a surface of 27.8 sq. ft. If these particles were at 1950° F. they would radiate 56.4 B. T. U. in .32 of a second.

As the furnace has 273 sq. ft. of radiating surface it could of itself radiate 552 B. T. U. if the radiant rays could get to the flying spray, but as I look at this matter it is not only a question of having the radiating surface sufficient to radiate the required amount of heat, but the surface must be in such a position that the radiant rays are not in-

tercepted by other bodies. The above is assuming that the temperature of the walls are 1950° F., and that the temperature of the black liquor particles were also at 1950° F. As a matter of fact we have reason to believe that the burning liquor particles have a temperature of from 2000° perhaps over 2150°, in which case they would have the power of radiating about twice as much heat as above given. As a matter of fact, the heat required for the evaporation of the water is only 19.7 B. T. U., so that we see that even at the lower temperatures we have sufficient heating surface to effectually dry the incoming liquor. As the smaller particles of this liquor take fire only a few inches from the nozzle we can imagine that we have them interspersed among larger particles which are constantly taking fire, and that nearly all the surfaces are radiating effectively heat to other parts of the liquor. In this case we do not have to consider the specific heat of the particles as it is evident that if they contain nearly all the total heat entering the furnace, that they can readily spare this small amount of heat without lowering the temperature below 1950° F., the temperature of the whole furnace. It may be argued that as they burn they

Table XI.
Diameter and thickness of black liquor particles. Analysis of field No. 16
atomized into atmosphere.

Diameter mm	Thickness mm	Diameter mm	Thickness mm	Diameter mm	Thickness mm
.0360	.00447	.127	.01243	.50	.0545
.0360	.00447	.161	.02890	.58	.0754
.0480	.00732	.197	.01640	.62	.0990
.0510	.01192	.232	.01990	.67	.0440
.0660	.01048	.259	.01640	1.1	.0717
.0660	.00994	.259	.01043	1.08	.0940
.095	.01048	.237	.01490	1.30	.0800
.119	.01340	.259	.02690	2.50	.0920
.119	.05018	.383	.05450		

Table XII.
Diameter and thickness of particles in front of furnace

Diameter mm	Thickness mm	Diameter mm	Thickness mm	Diameter mm	Thickness mm
.0360	.00447	.127	.01243	.50	.0545
.0360	.00447	.161	.02890	.58	.0754
.0480	.00732	.197	.01640	.62	.0990
.0510	.01192	.232	.01990	.67	.0440
.0660	.01048	.259	.01640	1.1	.0717
.0660	.00994	.259	.01043	1.08	.0940
.095	.01048	.237	.01490	1.30	.0800
.119	.01340	.259	.02690	2.50	.0920
.119	.05018	.383	.05450		

Table XII.

184,500,000 specks. 27.8 sq. ft. on this basis. Sp. Gr. Dry Black Liquor

Diameter, Volume, Surface of Black Liquor Particles at La Tuque in
mm or milligrams.

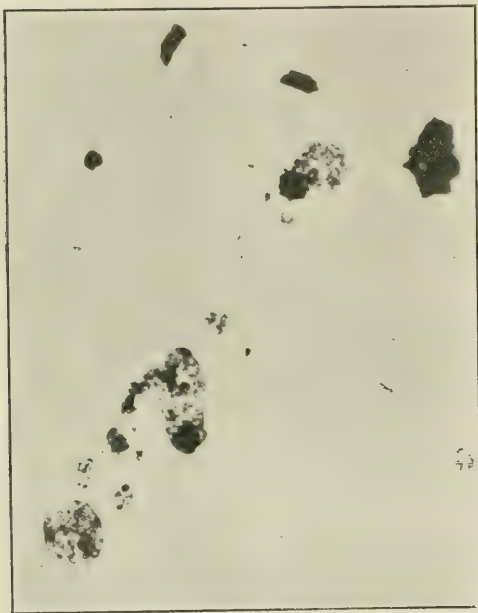
Flat Diam. mm	Flat Thick- ness mm	Wt. of each, mgms.	Vol. of each mm ³	Dia. if spherical mm	Surface of sphere	Partic- les 'cles' of ea- 'aver.' field	Total Wt. of particles in field mgms.	Total Sur- face of par- ticular field mm ²
a	.037	.00447	.1041x10 ⁻⁵	.4806x10	.02093	.1377x10 ⁻³	280	.00292
b	.077	.0104	.9931x10 ⁻⁶	.4842x10	.04557	.6524x10 ⁻²	169	.01678
c	.118	.0169	.3792x10 ⁻⁴	.1848x10	.07068	.1570x10 ⁻²	94	.03665
d	.143	.0186	.6127x10 ⁻⁴	.2986x10	.08294	.2161x10 ⁻²	86	.05269
e	.233	.0184	.1609x10 ⁻³	.7847x10	.1145	.4114x10 ⁻²	89	.14320
f	.333	.0242	.4322x10 ⁻³	.2107x10	.1591	.7949x10 ⁻²	66	.28520
g	.400	.0242	.6237x10 ⁻³	.3041x10	.1798	.1015	27	.16850
						311	.70494	16.4738

27.8 sq. ft. radiating surface of black liquor particles present at one time
viz., .32 second.

greater radiating surface, so even though the mass is smaller, the temperature will be maintained above the temperature of the furnace as long as there is combustible material left in the ash. The particles cannot fall below 1950, as that is the temperature of the entire products of combustion.

It must be remembered that the liquor in practice is exploded into a furnace running at a temperature of 1950° F. or over, according to strength of the liquor, amount of preheat and composition of the products of combustion, etc. Now we have evidence that when this is exploded into the hot furnace the subdivision is much more complete.

In photograph 2 is seen some of the smaller par-



Photograph I—Magnification 400 Diameters

ticles of black liquor undergoing disruption. In photograph 3 the honey-comb effect which precedes disruption is shown. In photograph 4 and 5 are seen specks where partial combustion has taken place which was evidently checked on striking the cold slide. You will observe how disintegration has proceeded.

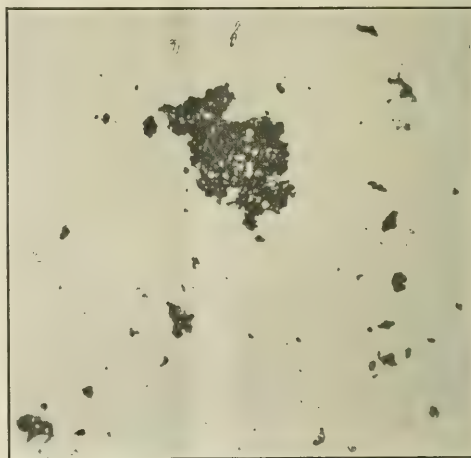
Now as this liquor burns up all but the very large particles while in transit of a distance of about 8 ft. we can assume that the ash of the liquor is in suspension in approximately the same amount as it enters the furnace. With an object then of finding the number of specks present in the ash I took some slides from the gases coming from the flue and also from the vibrating puffs at the front of the furnace.

Photograph 6 shows an average field of specks in front of the furnace and photograph 7 shows an

average field in the flue at back of furnace on the way to the precipitator. It will be noticed that there are some particles in photograph 7 which are larger than any of those in photograph 6. The reason for this is that owing to the inertia of the large particles that they were carried into a zone so far removed from the front of the furnace that they were not belched forth from the front of the furnace, but were carried by the flue gases and so show up on the slide at the back of the furnace. On the other hand, it will be seen in photograph 6 that there is not the large number of minute particles as in photograph 7. In this latter photograph you can notice the characteristic milky way occasioned by a great number of small particles, too small to be outlined with a magnification of only 200. Compare numbers in Table XIV and XV.

Table XIII shows the average diameters and thickness of the specks in front of the furnace. The dimensions are in millimeters.

Table XIV shows diameter in mm. volume in mm.³ surface in mm.², number of specks in a field and wt. and total surface in an average field of specks taken in front of a furnace, and we find that if we figured the number of specks from this field



Photograph II—Magnification 400 Diameters

that we should have 1,132,000,000 specks with a radiating surface of 319 sq. ft.

Table XV shows the diameter, volume, surface and weight of specks taken from the stock going to the precipitator. It will be noticed that those going to the precipitator have a much larger percentage of smaller particles.

If we figure all the ash in the particles of the size as coming from the back of the furnace we get 1,024,000,000,000 specks in the furnace at one time with a radiating surface of 332 sq. ft. has an entirely different function than to receive the heat from the hot gases by making steam.

(To be continued)

CHEMICAL INVESTIGATION

Efficiency and Control

ALL classes of work covered by the following subjects will be done for readers of "The Chemical Engineer" through this department: special research of every description; analysis and reproduction of any commercial product; prevention of waste and utilization of by-products on the most economical basis; valuation of raw materials; food analysis, and disputed points in regard to adulteration, labeling, and the enforcement of pure food laws; bacteriological and enzymatic examinations, including fermentation tests, pure yeast cultures, beverages of all

kinds; development of chemical inventions and industrial processes; examinations and advice on special machinery.

Inquiries of a minor character will be answered on this page, while major matters involving personal investigations, analyses, etc., will, if desired, be treated confidentially through the mails. All questions, materials for analysis, or letters leading to the opening of negotiations for special work will receive prompt attention if addressed to "The Chemical Engineer," 118 East 28th Street, New York City.

B. W. D.—Have received the samples of Charcoal, Acetate of Lime, Tar, Wood Alcohol and Crude liquor, also your data as to the quantities you are recovering, and will proceed at once with the investigation.

As requested by you, I will include in my report a sketch of the "chemical plant" as found necessary from the results of my experiments.

I would strongly advise that you reduce your output as agreed until the completion of this investigation.

S. O. D.—We can supply this working formula to you by mail only, as it is of such length that we cannot publish it here.

J. O. H.—It will be necessary for me to charge you a small fee for the determinations of nitrogen in the various samples of explosives you purpose sending me, on account of the care involved and the special apparatus required. A half-ounce sample of each will be ample for these tests.

L. J. T.—Am pleased to know you have disposed of your chemicals and colors to the industries I mentioned in my last letter.

The working formula for the manufacture of methylene violet will be ready to forward to you in a few days.

J. C. T.—The dry residue obtained from the activated sludge process of sewage purification has the following composition:—

Loss on ignition.....	70.4%
Mineral matter	29.6%
	100.0%
Nitrogen (N)	6.0%
Phosphate (P ₂ O ₅).....	4.2%
Grease, fat, etc. (by ether extraction)	7.3%

A. U. G.—A chemical analysis is by no means a working formula; the first simply states the general composition while the latter gives detailed instructions as to the commercial production.

Forward me the product and I will reproduce it and supply the working details within a week.

H. A. M.—I received the sample of buttermilk and after careful chemical analysis, find it to be a product of Bulgarian bacillus and not the old fashioned buttermilk that has been churned. Real buttermilk is

not made artificially, therefore when made from the above bacillus it is a direct violation of the State and National food laws, if sold under the name of buttermilk.

D. B. M.—Your request for the analysis of Pinus Palustris is given in full below:

Cellulose	58.48
Volatile Oil	1.30
Methyl Pentosan	3.60
Pentosan	7.46
Methoxy Groups	5.05
Soluble in 1% NaOH	22.36
" " Ether	6.32
" " Hot Water	7.15
" " Cold Water	6.20
Ash	0.37
Acetic Acid by Hydrolysis with 2.5% H ₂ SO ₄ ..	0.76

I have forwarded you the plans for the machinery etc., under separate cover.

B. B. B.—The sample of clay submitted to me by you for complete chemical analysis and identification has been finished with the results below tabulated:

SiO ₂	44.82
Fe ₂ O ₃	25.85
Al ₂ O ₃	2.63
CaO	7.51
MgO	1.97
K ₂ O	2.52
Loss on ignition	14.70
	100.00

Have also made a rational analysis of your sample, and report the following fractions:

Clay substance*	66.01
Quartz	32.52
Feldspar	1.47
	100.00

* The texture and grain of this refractory material suit it best for fireclay.

F. W.—The two samples of dyestuffs were received in a damp condition due to the absorption of moisture in transit. We would recommend that in the future you forward them in glass stoppered bot-

tles. The moisture content after four hours at 150 deg. C. was as follows:

"A"	7.85 per cent.
"B"	9.26 per cent.
"C"	9.62 per cent.

W. P. S.—Full details for the detection of the seven permitted food colors were forwarded you by mail; we strongly advise that you follow the scheme of analysis as outlined.

The sample of aniline green will be tested for arsenic and the result communicated to you at the earliest possible moment.

Those whose inquiries to this department have not as yet received attention must bear in mind that unless replies by mail are specifically requested, communications can only be considered in the order of their receipt.—Editor.

German Potash Industry

Socialization of Industry Aimed at by Leaders of German Industry

SOCIALIZATION of the German potash industry is the purpose of a law which went into effect last spring, a detailed in a report by Commercial Attache Paul L. Edwards, stationed at The Hague, to the Department of Commerce. It gives the workers a larger share in the management and profits of the industry and unifies its activities under Government control. The provisions of the new law, which supercedes the Potash Law of 1910, vest the control of the entire potash industry in a State Potash Board. This board is composed of eight members representing employes of potash mines and factories, eight representatives of owners of such mines and factories, and fourteen representatives of various other phases of the industry, including consumers, dealers and technical experts.

The details of the reorganization and management of the industry are not prescribed in the text of the law, but are to be worked out by a board of experts and presented to the Government for approval. This board, like the State Potash Board, is composed of representatives of various interests, including consumers of potash, and its personnel is selected by the Government, partly from nominations made by employers and employes' associations.

Use of Oil Shales

Oil Shales Have Great Possibilities if Development Is Pushed

SHALES containing "kerogen," or bituminous matter, which on destructive distillation yield oily and tarry matters resembling petroleum are here designated as oil shales. They differ from oil bearing shales from which petroleum may be obtained by so-called mechanical means. The educts obtained by the destructive distillation resemble some or all the varieties

of petroleum, depending on the character of the shale and the mode of treatment. Some shale oils have a paraffine base, some an asphaltic base or a combination; some run high in sulphur compounds. The methods of refining and cracking therefore are essentially the same as are used in refining petroleum.

In 1860 in this country over fifty companies were successfully distilling various bituminous natural materials for the production of "coal oil" used for illuminating purposes. The discovery of petroleum and the failure of these companies to save and utilize the valuable by-product, ammonia, brought about their inevitable doom. Prior to that time more or less successful efforts were made to produce from the shales of Scotland oils for illuminating and heating purposes. Competition of native petroleum from the United States early eliminated some of these companies and with the entrance of oil from the Russian and other fields into the world's markets the Scottish oil shale industry underwent serious and trying experiences until in 1916 only four (Scottish) were paying concerns. These survived only through energy and the application of skill in saving valuable by-products.

A few companies have successfully operated in France and New Zealand. The Canadian Government showed active interest in the new Brunswick shales, which exist in quantity and are more valuable than the Scottish shales. The retarded development of that very valuable asset of the Province of New Brunswick involves a pathetic history, which is lamentable. This was especially true when the product was so much needed in the prosecution of the war.

General Chemical Co.

Annual Statement Reflects Prosperous Condition of Corporation

STATEMENT of the General Chemical Co., for the ten months ended October 31, 1919, as submitted to the Stock Exchange, shows surplus after charges of \$3,678,447, equivalent after preferred dividends to \$18.13 a share earned on the \$16,519,200 common stock.

Income account for the ten months ended October 31, 1919, follows:

	10 Months
Net profits	\$5,473,223
Insurance fund	170,000
Depreciation	1,624,776
Balance	\$3,678,447
Preferred dividends (9 months)	684,373
Common dividends (9 months)	991,152
Surplus	\$2,002,022

Japan's importations of caustic soda and soda ash from Great Britain during the first eight months of 1919 amounted to 49,194,291 kin against 20,887,054 kin in the same time last year and 20,448,824 kin in the corresponding period two years ago.

The Activation of Carbon

The Close Study of Amorphous Carbon Made During the Course of the War, in an Attempt to Develop Its Fullest Possibilities, Revealed the Fact That It Possessed a Number of Qualities Indicative of a Wide Industrial Future.

By N. K. CHANEY*

THE war has brought into existence, as an article of commerce, a new product known as "activated carbon."

Originated as a means of defense against toxic gases in warfare, this material is rapidly finding industrial applications, the extent and novelty of which are not as yet generally appreciated.

The development of activated carbon represents something more than a mere improvement in older forms of adsorptive carbon, or in older processes. It stands for a new viewpoint as to the general nature of so-called amorphous carbon.

Carbon has been hitherto defined as existing in three distinct modifications, diamond, graphite and amorphous. The latter term has comprised a heterogeneous assortment of natural and artificial carbon materials, possessing a variety of widely different physical and electrical properties, such as manifestly could not be explained by a single allotropic modification of elementary carbon.

Thus, while the complexity of so-called amorphous carbon has long been recognized, we are beginning for the first time to obtain a rational idea of its individual components and their relations to one another.

Some of these ideas and relationships have been indicated in a general way in a recent point paper³ by A. B. Lamb and the writer.

In other accounts of the work of the Bureau of Mines⁴ and of the Chemical Warfare Service⁵ are related the circumstances which led the National Carbon Co. to devote its Research Laboratory to the development of a satisfactory adsorbent charcoal for the American Army.

In accepting this problem, contrary to the popular impression, we possessed no special knowledge of vegetable charcoals, or special acquaintance with the processes and literature regarding the preparation of adsorbent and clarifying materials.

We assumed at the start that whatever general knowledge existed in these fields was inadequate to a solution of the problem, otherwise the stress of two years' gas warfare would have brought about solutions of which the Government would have had adequate information. We were strangely ill-informed of the partial success already obtained by England, France and Germany.

Thus the belief that no adequate protection existed against certain toxic gases, and our lack of information regarding the methods and results obtained by others in the field provided the compelling stimulus for a new and fundamental investigation of the first principles of adsorptive activity in carbon.

The result of this intensive research was the gradual development of a broad general conception as to the nature of active carbon and its relations to the generally occurring forms of carbon.

This general theory in its complete form rests upon two independent, experimentally established postulates.

(1) That elementary carbon (other than diamond and graphite) exists in two modifications, "active" and "inactive," or *alpha* and *beta*.

(2) That all "primary" amorphous carbon consists essentially of a stabilized complex of hydrocarbons, absorbed on a base of "active" or *alpha* carbon.

We will discuss these primary postulates in order.

The active modification of carbon is characterized by a high specific adsorptive capacity for gases, etc. The inactive modification carbon exhibits no special adsorptive capacity whatever.

In addition to this distinction in specific adsorbing power, active and inactive carbon differ in two other important particulars, i. e.:

(1) Temperature of formation.

(2) Chemical activity, or susceptibility to oxidation.

The active modification is formed whenever carbon is deposited at relatively low temperatures by chemical or thermal decomposition of carbon-bearing materials; in general below 500 to 600° C.

The inactive modification results from similar decomposition at higher temperatures, in general above 600 to 700° C.

The active form is rapidly attacked by oxidizing agents. Dr. Hulett has shown that slow oxidation occurs at room temperatures. The inactive form is relatively stable toward oxidizing agents, resembling graphite in this particular.

It would be premature to assert that these two forms of carbon are true allotropic modifications. It is not yet established that both forms are amorphous. Attempts to find a transition temperature or to convert *alpha* into *beta* carbon have been tried without definite success at temperatures up to 1600 degrees C.

This much is established. The two forms are distinct and easily differentiated, both by their prop-

*A paper presented at the thirty-sixth meeting of the American Electro-Chemical Society, Chicago, September 3-25, 1919.

²Research and Development Laboratory, National Carbon Co., Inc., Cleveland, Ohio.

³J. Ind. and Eng. Chem. (1919), 11, 420-467.

⁴Bull. 178-A War Gas Investigations, Bureau of Mines.

⁵J. Ind. and Eng. Chemical (1919), 11, June and April number.

erties and conditions of formation. Hydrocarbons, such as menthane, ethylene, benzene, etc., of the decomposition points of which are normally above 700 degrees C. in general only give inactive carbon. Hydrocarbons such as acetylene may be cracked as low as 300 degrees C. may give active carbon at lower temperatures and inactive carbon at higher temperatures. The temperature at which molecular carbon is set free is apparently the controlling factor in determining whether it is the active or the inactive variety.

In the ordinary process of distillation of carbonaceous materials at relatively low temperatures, active carbon is first formed by the thermal decomposition of unstable hydrocarbons. By virtue of its specific adsorptive properties this active carbon adsorbs a further quantity of hydrocarbons and these hydrocarbons are thereby stabilized to a remarkable extent, so that they are retained under conditions of temperature, pressure, etc., at which they would otherwise be quickly eliminated as such or suffer decomposition. For example quantities of a hydrocarbon resembling anthracene, the boiling point of which is 360 degrees C., have been isolated from cedar charcoal which has been previously calcined to 850 degrees C. In the same manner chlorine substitution products of hydrocarbons may be obtained in quantity by passing chlorine gas at high temperatures over coconut or other charcoals which have been calcined to similar temperatures. This illustrates the power of active carbon to stabilize its adsorbed materials.

This stabilized complex of hydrocarbons adsorbed of active carbon is the product which we have defined as primary carbon, because it is the original product first occurring in low temperature distillation of carboniferous materials. Many commercial grades of animal and vegetable charcoal are of this character: as are also such cokes as result from the low temperature distillation of bituminous coals, mineral bitumens, etc.

Anthracite coals may be regarded as native primary carbons since they have been shown to possess an active carbon base saturated with adsorbed hydrocarbons.

Bituminous coals may be similarly regarded, although their hydrocarbon content is in great excess of the adsorptive capacity of the active carbon base. Such excess may be readily removed by distillation under proper conditions.

Ordinary coke on the other hand is heavily charged with inactive carbon resulting from the gas treatment to which it has been subjected i. e., the decomposition in its of volatile hydrocarbons at high temperatures. Sudden heating of primary hydrocarbons to very high temperatures results in the decomposition of the adsorption complex and the sudden liberation of its hydrocarbons at temperatures much above their normal decomposition point.

The latter then break down, forming inactive carbon deposits upon the active carbon. In this way a primary carbon may become self gas treated.

Thus the carbon products resulting from the gas treatment of primary carbon at high temperatures by volatile hydrocarbons, either self contained or introduced from without may be properly termed secondary carbon, which thus possesses a variable composition of active carbon, hydrocarbons, and inactive carbon, depending upon the extent and conditions of the gas treatment.

Primarily carbon is therefore essentially an adsorption complex of hydrocarbons adsorbed by a base of active carbon, with or without associated non-absorbed hydrocarbons.

Secondary carbon is primary carbon partially or completely broken up with the formation or introduction of inactive carbon by the high temperature decomposition of its hydrocarbons.

From the above description it is self evident that primary carbons as such will not possess a high specific adsorptive power, the active carbon being saturated by the hydrocarbons adsorbed by it. The process of activation must therefore consist fundamentally in the separation and removal of the hydrocarbons from the active carbon.

The correctness of the general principles just outlined has been substantiated in a very interesting way. According to theory carbon deposited at low temperatures and absolutely free from hydrocarbons should be the purest form of carbon and require no activating process. Therefore carbon was prepared from the reaction $2CO = C + CO_2$ at 300 degrees C. using ferric oxide as a catalyst.

The carbon so formed in removal of the iron proved to a specific adsorptive capacity appreciably greater than the best samples of carbon prepared from hydrocarbon sources.

The practical elimination of the hydrocarbons from the primary carbon is, however, extremely difficult.

Because of the stability of the adsorption complex, the temperatures required to accomplish this thermally are so high that secondary formation of inactive carbon by self gas treatment is inevitable. Prolonged heating for days under carefully controlled conditions will partially accomplish the desired object, yielding an impaired and gas-treated product which contains a small amount of active carbon. To secure even partial success with this method requires specially selected and prepared forms of primary carbon, in which the character of the hydrocarbon content is such that either the stability of the adsorption complex is lessened or the tendency to gas treatment is a minimum.

Having independently discovered the essential principles of this method it was abandoned because of its practical limitations. It was later found that the British and the French had developed this

method to the commercial stage of manufacture.

The second general method of activation suggested by this theory is to attack the primary carbon by some form of selective chemical action. The most successful of these is differential oxidation. It has been shown that the adsorption complex could be broken down and the hydrocarbons oxidized or partially decomposed and distilled away from the active carbon.

Production of Carbon.

While many forms of oxidation, both wet and dry, gave some degree of separation and consequent activation, the yield and quantity of activated carbon obtained varied greatly with the kind of oxidizer used and the manner of its control.

Since inactive carbon is highly resistant to oxidation it is essential to the proper practice of activation by controlled oxidation that the formation of inactive carbon be avoided at every stage of the operation, including the production of the primary carbon itself. At the same time considerable latitude is permissible for the reason that the tendency to gas treatment varies with the chemical nature of the adsorbed hydrocarbons, i. e., with their decomposition points.

Hydrocarbons present in bituminous coals are found to deposit inactive carbon more readily than hydrocarbons derived from certain other carbon complexes, such as may be prepared from certain woods and nuts. Hence it is that the adsorptive carbon of commerce was hitherto produced only from the latter sources, and not by reason of any inherent impossibility of preparing active carbon from coals, petroleum and other mineral deposits.

The commercial developments of the oxidation principle as worked out by us and adopted by the Chemical Warfare Service consisted in the aid process, the steam process, and later the use of CO_2 .

The discovery of the availability of anthracite and natural coals and the possibility of manufacturing synthetic primary carbon from pulverized materials by the use of the usual binders employed in carbon manufacture saved us from a critical shortage of nut materials in the latter months of the war.

The special forms arising from these developments were known by the Gas Defense as Dorsite made from cocconut, Bachite made from anthracite, and Carbonite a synthetic product made by carbon manufacturing processes, from lampblack, powdered coal, or other suitable materials.

The underlying principles of the theory as to the nature of primary carbon are strongly confirmed by the fact that two entirely different methods of activation suggested by it, i. e., controlled distillation and differential oxidation are in some degree effective.

A modification of the second method is also suggested by the theory, which would consist in the

addition of chemical reagents to act catalytically or directly during the primary carbonization to break down the stabilized hydrocarbons at temperatures below the critical range in which inactive carbon is formed.

This method was successfully employed by us to duplicate German war-charcoal, thus indicating the method by which the latter was formed, which consisted in impregnating wood with various metal salts before carbonization, and later extracting with acid. This was afterwards verified by the Army Commission visiting Germany.

Product of Another Process.

The amount of active carbon formed by this method is very small in comparison with the better methods of selective oxidation. On the other hand, the extraction of the dispersed inorganic material leaves a very fine and effective capillary structure capable of adsorbing large quantities of gas at high concentrations of the latter. In this connection it is necessary to explain that we have clearly shown the possibility of differentiating between two types of adsorptive capacity, one due entirely to the arrangement and physical structures of the adsorbent, which we term the capillary capacity, and a second type characteristic of the material of which the adsorbent is constituted. Capillary capacity is distinguished by large capacity at high gas concentrations and by rapid equilibrium between adsorbent and gas phase, in either direction, the gas being removed as readily as it is adsorbed. Specific capacity is characterized by very considerable capacity at low gas concentrations, and by extremely low rate of loss during reversal of the adsorption process.

Thus by saturating an adsorbent and then noting the rate at which different portions of the adsorbed gas are removed, it has been found possible to evaluate the specific and capillary components of the total adsorptive capacity.

The weight of gas retained, after rapid weight loss has ceased, called the "retentivity" of the adsorbent, is a measure, therefore, of the proportion of active carbon present, in a given weight of adsorbent. This test applied to pre-war charcoals shows that their adsorptive capacity is almost wholly capillary and dependent upon the physical structure left by distillation in the primary carbon. In general even this capacity is extremely small compared with present standards.

German charcoal is distinguished by the very high ratio of capillary to specific capacity. On the standard accelerated tube tests employed by the Chemical Warfare Service, German charcoal thus showed up very well because of the high concentrations of gas employed. If one were to breathe through the coal at the end of such a test, however, one would soon inhale 75 per cent. or so of the gas previously absorbed. Thus German charcoal received for a time

a wholly unwarranted reputation as we now see.

We have now outlined a general theory of the nature of amorphous carbon and the principles underlying the successful isolation of active carbon.

As a working hypothesis the conceptions above outlined have proved their worth by enabling us to develop methods for the commercial manufacture of adsorbent and catalytic carbon of a character unapproached in pre-war charcoals and from a variety of raw materials hitherto considered useless for such purposes.

Varieties of Carbon.

Upon the chemical side we have provided a new means of attack upon the problems of the structure and constitution of the various forms of amorphous carbon.

The actual development of the two principal conceptions underlying the complete theory was the reverse of the order of exposition. At the outset of the work the fundamental question was why and how adsorbent charcoals differed from other charcoals less adsorbent.

Because of the vital urgency of the problem at that time and the need or haste, we knew that it would be fatal to back a wrong hypothesis. So far as we could learn the following hypotheses were current:

(1) That a special form of hydrocarbon film was left under certain conditions of distillation which was especially active.

In the case of such gases as chlorine which may form substitution products, such a possibility certainly exists even in the light of present developments.

(2) That adsorption depended upon the physical structure of the adsorbent, i. e., the diameter of the capillary pores.

As we have seen, this actually represents the type of adsorption previously common in adsorbent materials, other than active carbon, but is not the type of specific adsorption desired for effective field protection against low concentrations of toxic gases.

(3) That adsorptive power depended upon the quantity of fixed gases as carbon monoxide, oxygen, etc.

The difficulty with the latter view was that, if true, it suggested no line of attack.

After considering the above we adopted the hypothesis that absolutely pure amorphous carbon would be active, and that the most obvious impurities in charcoals formed by destructive distillation were hydrocarbons.

It was by no means readily accepted by many chemists that ordinary low boiling hydrocarbons could exist as such in chars which had been heated up to nearly 1,000° C. for hours.

The crucial experiment was therefore the proof that ordinary hydrocarbons resembling anthracene

for example could be removed as such from a charcoal previously calcined to 850° C. by simply distilling it in the presence of air at 300° C.

This not only proved the existence of the hydrocarbons, but indicated directly that by oxidation they could be broken down from the adsorption complex. No explanation was forthcoming, however, as to why certain forms of carbon could be activated while others could not.

It was not until work was commenced on coals and artificial carbons that the significance of the decomposition temperature of the carbon was discovered.

This clue cleared up the entire field and provided the explanation for many previous anomalies, as why, for example, artificial carbons taken from the same furnace could, some of them, be activated and others not. Our observation that all forms of retort cokes were wholly inactive and incapable of activation was also explained. The fundamental conditions surrounding the formation of primary carbon, if the latter was to be capable of activation, were thus completely defined.

To sum up, active carbon is essentially a special form of pure amorphous carbon, deposited at low temperatures and free (1) from adsorbed stabilized hydrocarbons which are normally associated with it and which lessen its power of combining with other substances; (2) from inactive carbon formed by gas treating, i. e., by the decomposition of hydrocarbons upon its surface at high temperatures.

It is possible for the first time to prepare intelligently such active carbon on a large scale from whatever sources of carbon-bearing material may be cheapest or most desirable for the particular purposes in view.

The unique properties of this material both as catalyst and adsorbent suggest that it will find many industrial applications.

New Synthetic Dye

The Baird-Stern Chemical Company of New Orleans, according to newspaper reports from New Orleans, has concluded negotiations with the Carex Company of New York, whereby the southern firm will supply two hundred tons of a synthetic indigo product manufactured by it. The New Orleans firm is enlarging its plant.

Denatured Alcohol

According to a recent ruling of the Acting Commissioner of Internal Revenue at Washington, receptacles in which the completely denatured alcohol is contained must hereafter bear not only the present label, but the word "Poison" in large red letters, the skull and crossbones symbol and the following statement:

"Completely denatured alcohol is a violent poison. It cannot be applied externally to human or animal tissue without serious injurious effect. It cannot be taken internally without inducing blindness and general physical decay, ultimately resulting in death."

The Bureau of Chemistry

Work Done During Year Varied and Productive as Ever

ENFORCING the Federal Food and Drugs Act, developing methods in food distribution, finding uses for waste products, aiding industrial development by working out technological processes and reporting the results of chemical research, are features of the work of the Bureau of Chemistry. United States Department of Agriculture, during the last fiscal year, as outlined in the recently published report of the Chemist and Chief of Bureau, Dr. Carl L. Alsberg.

Although the staff of the Bureau was greatly depleted because of the unprecedented demand of the industries for experienced chemists, the volume of the work and the results accomplished in the technological and regulatory activities of the Bureau compared favorably with previous years, says the report. A larger number of prosecutions and seizures were effected than in any previous year.

Slack-filled cans, decomposed eggs, fake egg substitutes, butter containing excess water, glue sold as edible gelatin, olive oil adulterated with cheaper oils, frozen oranges, canned tomatoes adulterated with water, "soaked" oysters and scallops, cocoa adulterated with cacao shells, adulterated and misbranded vinegar, falsely labeled and adulterated stock feeds and misbranded medicines were among the violations of the Federal Food and Drugs Act, on which 1,052 seizures and 843 criminal prosecutions, inaugurated during the year, were based. Other products involved in the regulatory activities because of adulteration or misbranding, or both, were beverages, extracts, flavors, candy, coffee, tea, food colors, milk, cream, crude drugs pharmaceutical preparations, fruits, jams, jellies, lard, meat, poultry, nuts, syrups, spices, vegetables and water.

Progress is reorted in the work of the Bureau on developing better methods for handling, packing, shipping and storing poultry, eggs and fish in order to reduce losses while in the channels of trade from producer to consumer, and to bring about more economical distribution of these perishable products. It has been demonstrated that the use of 100-pound boxes in place of barrels for shipping fresh fish prevents damage and loss from the pressure and bruises to which fish in the bottom of the barrels are subjected. Producers were instructed in the packing of fish, the loading of refrigerator cars and the building and equipment of fish freezers. Carload shipments of fish from Florida to Savannah, Louisville, Nashville and Indianapolis were supervised.

Constructive methods for conserving foods from the season of plenty to the time of scarcity and means for preventing loss from spoilage have been developed as the result of research and experimental work. Special attention was given to the developemnt of an industry for drying fruits and vegetables with a view

of improving the attractiveness and the quality of the product. Commercial methods and machinery for drying have been studied. Laboratory investigations on an extensive scale were undertaken to compare the nutritional qualities of dried products with those of canned and fresh material. The results have been favorable. The drying work on the whole has been of practical assistance in establishing a sound, permanent industry.

Work on the preservation of foods by fermentation and brining has been continued. Studies are under way to improve the manufacture of pickles and prevent the losses that occur at present because of softening of the pickles during storage. Improved methods for the manufacture of sauerkraut have been developed in co-operation with manufacturers. The first complete and critical survey of the fat and oil industry of the United States was made in co-operation with the United States Food Administration, and the results, with statistics of the industry, have been published.

Corn cobs, one of the largest waste by-products of farming, may now be utilized as the result of processes which have been worked out and patented for the preparation from corn cobs of adhesive gum and of the rare sugar xylose.

America's Oil Resources

Government Should Encourage American Development of Foreign Fields

DRASTIC action must be taken to assure the United States of a future oil supply either by conserving the supply in this country against foreign encroachment or by encouraging American capital to enter foreign fields to assist in their development, thus assuring an additional supply of oil for our needs, according to George Otis Smith, Director of the United States Geological Survey. In a paper which is to be read at the February meeting of the American Institute of Mining and Metallurgical Engineers, he calls attention to the fact that the consumption of oil is rapidly increasing and that additional heavy demands will be made upon supply with the advent of an American merchant marine. The encouragement of American capital in foreign fields he believes offers the better solution and holds that the Government should give its moral support to such undertakings.

In discussing the situation he says in part:

"The position of the United States in regard to oil can best be characterized as precarious. Using more than one-third of a billion barrels a year, we are drawing not only from the underground pools, but also from storage, and both of these supplies are limited. Last year the contribution direct from our wells was 356,000,000 barrels, or more than one-twentieth of the amount estimated by the survey geologists as the content of our underground reserve; we also drew from storage 24,000,000 barrels, or nearly one-fifth of what

remains above ground. Even if there be no further increase in output due to increased demand, is not this a pace that will kill the industry? Even though we glory in the fact that we contributed 80 per cent. of the great quantity needed to meet requirements of the Allies during the war, is not our world leadership more spectacular than safe? And even though the United States may today be the largest oil producer and though it consumes nearly 75 per cent. of the world's output of oil, it is not a minute too early to take counsel with ourselves and call the attention of the American geologists, engineers, capitalists and legislators to the need of an oil supply for the future.

"Two methods of handling the problem of a future oil supply suggest themselves: either reserve the domestic oil fields for American development and thus prevent foreign acquisition of what is needed at home, or encourage our capital to enter foreign fields to assist in their development, thus insuring an additional supply of oil for our needs. The one method harks back to the 'Chinese wall' period; the other expresses the 'open door' policy. At present the United States Government follows neither method; the British Government has adopted both.

"American geologists, American engineers, American drillers, and American rigs and supplies have been utilized in British oil exploration and we may well reciprocate by adopting the British policy of encouraging the acquisition by its nationals of petroleum supplies in foreign fields. American capital as well as American engineering should be encouraged to help develop the new fields and so do its part in insuring the continuance of this source of power for future generations at home and abroad.

"The part of the Government is to give moral support to every effort of American business to expand its circle of activity in oil production so that it will be co-extensive with the new field of American shipping. This may mean world-wide exploration, development and producing companies, financed by United States capital, guided by American engineering, and safeguarded in policy because protected by the United States Government. Thus only can our general welfare be promoted and the future supply of oil be assured for the United States."

Alcohol from Coke Gas

English Chemist Produces Motor Spirit from
Coke Oven Gas

EXTRACTION of ethylene, alcohol and their derivatives on a commercial scale from coke oven gas is an accomplished fact. Ernest Bury of the Skinningrove Iron & Steel Works, told the Cleveland Institution of Engineers in a paper describing the work at the Skinningrove plant, which was characterized by Dr. J. E. Steads as "an epoch-making record."

The work is still to some extent in the experimental

stage, but Mr. Bury has succeeded in producing a perfect motor spirit, and as the adoption of the internal combustion engine is rapidly developing, the importance of this discovery is apparent. The world's liquid fuel resources are limited, while the consumption is growing by leaps and bounds.

The practical working of Mr. Bury's process at the Skinningrove works, where 5,800 tons of coal are carbonized per week, has revealed an average yield of 1.6 gallons of alcohol per ton of coal carbonized, and as the total weight of coal which was reduced to coke in this country in 1918 was 14,635,000 tons, the application of this process to the whole of this coal would yield, according to Mr. Bury's calculation, 23,416,640 gallons of alcohol, represented at 2s per gallon a sum of £2,341,664. Having regard to the scarcity of liquid fuel, that in itself is important, and as Mr. Bury declared, it is national suicide to continue to burn any substance which might be converted into liquid fuel. But the possibilities do not end there. He pointed out that the recovery of alcohol at the gas works of the country would yield a further 27,000,000 gallons, or, taking alcohol and benzol together, the total quantity of liquid fuel available for extraction through the carbonizing of coal would be 114,000,000 gallons as against the country's present total requirement of 100,000,000 gallons per annum.

The process of extraction by contact with sulphuric acid is not a new discovery, but Mr. Bury has been the first to establish it as a commercial proposition. His principal discovery is that the best results are achieved at a temperature of 60 to 80 degrees centigrade, and in his process he has carried the utilization of heat from the coke oven plant to the utmost limit. Ether, chloroform, iodoform, acetic acid and acetone are among the derivatives he has obtained from this coke oven gas after the benzol has been extracted, and at the meeting at which these results were disclosed some of the foremost metallurgists of the day, amongst them Dr. J. E. Stead, paid tribute to the progressive policy of the company at whose works these experiments were carried out.

The Strength of Glue

The Forest Products Laboratory, U. S. Forest Service, Madison, Wis., describes in Bulletin F-32 a new method for determining the jelly strength of glues.

The mechanical method outlined in a plate of working drawings furnished by the laboratory is said to be fully as sensitive as the finger test, and has the advantage of furnishing numerical results by which accurate comparison of different glues may be made.

Lime is probably the most essential constituent used with casein to produce casein water-resistant glue. Commercial lime varies widely in purity, but the degree of purity, according to tests made at the U. S. Forest Products Laboratory, is not a determining factor in glue making. Bulletin F-31, issued at Madison, Wis., gives some interesting studies at that laboratory.

Wants Bonus Returned

Stockholder of Cyanamid Company Objects to Bonus Distribution

THE officers and directors of the American Cyanamid Company are defendants in two suits filed at White Plains by Charles H. Baker, a large stockholder, and one of the organizers of the company, which have as their object the forcing of a return of money paid out to officers and managers of the company as bonuses in the last two years and a distribution of some of the large earnings to the common stockholders.

It is asserted in the complaint by Mr. Baker that the bonuses paid have been the equivalent of about 5 per cent. on the common stock and that these have been received by the officers in addition to large salaries paid to them under their contracts. The President of the company, Frank E. Washburn, it is stated, receives a salary of \$25,000 and the Vice-President, K. F. Cooper, \$10,000.

Just who participated in the bonuses Mr. Baker says he has been unable to find out, the fund for the last two years, which amounted to approximately \$350,000, having been distributed by what the defendants term a disinterested committee made up of James B. Duke of Somerville, N. J.; W. R. Cole, of Nashville, Tenn., and S. T. Morgan of Richmond, Va. The distribution is described in the complaint as "illegal, contrary to good conscience and equity and is in fraud of the minority stockholders of the corporation and of the corporation itself."

According to the attorney for the plaintiff, Elijah N. Zoline, the case will bring out in a small way many of the questions involving distribution of profits which were a cause of contention between Henry Ford and the Dodge Brothers in the suit which was decided not long ago. Another feature of the complaint is that it declares the action of the directors in withholding disbursements on the common stock has been done with the idea of depressing the price of the shares which have fallen in value from about \$75 to \$30, although the earnings of the company during the decline have been increasing. This policy, it is asserted, has been followed with the idea of discouraging the small stockholders so that they will dispose of their stock. The plaintiff holds that the asset value behind the common shares is \$150. The decline in stock value, it is said, renders it impossible for the plaintiff to dispose of his holdings of 1,000 shares except at a heavy sacrifice.

The American Cyanamid Company was organized in 1907 to manufacture nitrogen from the air. It manufactures fertilizers and during the war manufactured nitrates for explosives. The company also controls the Air Nitrates Corporation formed in 1917 as agent for the United States Government in the construction and subsequent operation of plants for the manufacture of ammonium nitrate by the cyanamid process. The company constructed three plants, one at Muscle

Shoals, one near Cincinnati, and another near Toledo. The capital stock of the Air Nitrates Corporation is carried at par, \$1,000, in the 1919 balance sheet.

The complaint sets forth that the net profits of the Cyanamid Company have been in excess of \$1,000,000 annually and are growing because of the exclusive field which the company occupies. It is held that a working capital of \$350,000 is all that the company needs and that the surplus made up of accrued profits or other liquid resources in excess of that amount, should be distributed to the common stockholders. The surplus on June 30, 1919, amounted to \$1,723,529.

The defendants contend that the bonuses were distributed to bring salaries up to a figure commensurate with the worth of the men receiving them. The outstanding preferred stock of the company amounts to \$7,994,200 and the common stock to \$6,594,300.

New Merger Effectuated

General Fire Extinguisher Company and Grinnell Co. Amalgamate

ON January 1st, all of the sales and contracting business which has formerly been carried on by the General Fire Extinguisher Company will be taken over by Grinnell Company, Inc. This change is made because the old name so specifically described the automatic fire protection section of the company's business that it prevented any natural assumption on the part of the public that the company was engaged in several closely related lines of business.

As a matter of fact, the company's business is based fundamentally on industrial piping, and it is perhaps the largest concern in the United States doing exclusively that sort of work.

The business from which Grinnell Company, Inc., has eventuated was founded in 1850. The basis of the original business was not fire protection, but steam and gas piping. Working along these lines the company was splendidly organized to meet the large industrial demands which came with the business expansion that followed the Civil War. This gave the company an early dominance in steam engineering, especially in New England.

In the early 70's a special line of work developed through the adoption of perforated pipe systems for fire protection. This crude form of protection was soon supplanted by automatic sprinklers, in the manufacture and installation of which they were pioneers.

The growth of the sprinkler section of the business was rapid, but the executives of the company, even under such circumstances, continued to develop other lines of piping equipments, always seeing to it that its engineers kept abreast of the most modern practice.

ACCORDING to the Manchester, N. H., Union, work has been started at Portsmouth, N. H., on the new chemical works which are to occupy the old Shattuck shipyard.

Nitrate Plant Justified

Baruch Claims Muscle Shoals Saved \$300,000,000 During War

BERNARD M. BARUCH, Chairman of the Raw Materials Division of the War Industries Board, during the course of the war, took full responsibility for the construction of the various government nitrate manufacturing plants in different parts of the United States, during the latter days of the war, in the course of testimony given before a Congressional subcommittee, sitting in the New York Customs House. The construction of these plants freed the United States from the domination of the Chilean nitrate miners, and thus justified their existence.

"If the war had lasted six months longer," said Mr. Baruch, "the wisdom of constructing these huge plants would have been apparent. The Allies then would have been independent of the Chilean nitrate beds, where there was a delicate situation through the activities of German agents, and the American nitrate plants, particularly the \$62,000,000 plant at Muscle Shoals, Alabama, would have saved their cost many times over even if they had never produced a single pound of nitrate. These plants, he said, brought down the price of Chilean nitrate to such a level that the total saving was more than \$300,000,000.

"Production of nitrates through the air-fixation process," continued Mr. Baruch, "was planned to make this country totally independent of the Chilean supply, which was fraught with so many dangers of German influence. Had not these plants been built with their threat of not only war-time, but peace-time competition, speculators would have gouged the United States out of hundreds of millions of dollars.

"We found that nitrate produced in Chile," said Mr. Baruch, "had risen from eight to sixteen shillings a quintal. This would make a difference of about \$40 a ton to us, or between eighty and a hundred million dollars for a year. But when we started our program to produce nitrate in the United States the price of Chilean nitrate dropped."

Mr. Baruch thought that some governmental action was necessary to produce nitrates in this country in order to remain independent of Chile, but he believed as much as possible, should be produced through private enterprises. He will be heard again by the Congressional Committee, probably in Washington.

E. L. Reggonet, a French mechanical engineer, who installed machinery at the Muscle Shoals plant, testified that it would cost millions to convert the Muscle Shoals plant so that it could produce fertilizer.

Testimony that money had been wasted in the construction of the Muscle Shoals plant was given by John Stross, who was garage manager at the plant. "Automobiles damaged in smash-ups," he said, "were sent to the scrapheap and more requisitioned."

Captain Stephen L. Coles testified that he had to "fight" to get information for the Government and had many disputes with company officials.

A New Steel Invented

Arnold of Sheffield Now Making Molybdenum Steel

PROF. JOHN OLIVER ARNOLD, Professor of Metallurgy at Sheffield University, according to a report published in a recent issue of The Daily Mail of London, England, to have invented a new high-speed steel far superior to any high speed steel so far produced.

Professor Arnold, who is said to have been the discoverer of vanadium steel, claims, according to The Daily Mail, that the new steel possesses far more commercial possibilities, that it is unrivaled in hardness, that in tool form it will remove a greater weight than any other steel, and that it possesses comparatively longer life.

The Daily Mail indicates that Professor Arnold uses molybdenum instead of tungsten, and says:

"If large quantities of molybdenum can be found and the price reduced, tungsten will take a back seat, because 6 per cent, molybdenum will achieve more than 18 per cent. tungsten."

Professor Arnold, says the newspaper, is prevented under the Defense of the Realm act from utilizing his invention industrially. He is patenting his invention in England and America, and will be allowed to proceed with his American patent on condition that he publishes nothing concerning it.

A representative of the American Government, it is said, made a special journey to Sheffield to investigate Professor Arnold's discovery. The Daily Mail expresses the fear that the United States will get ahead of Great Britain on an important discovery.

"The M. I. T. Plan"

Experts on Staff May Be Retained by Industrial Corporations

THE Massachusetts Institute of Technology, Cambridge, Mass., is beginning to approach the industries of the country with a plan of co-operation which has for its immediate objective the raising of funds to provide more nearly adequate salaries for the members of its instructing staff.

Briefly stated, the Technology plan of education consists of the institute being retained in a consultant capacity on an annual salary basis by the various industries. In return for the fee the institute agrees to permit the corporations retaining her to make use of the institute's extensive library, files and plant, and to consult with the members of her staff and faculty on problems pertaining immediately to the business of the company.

In a special dispatch to the New York Times, Sir Ernst Rutherford the English physicist denied that he had discovered a method of transmuting the elements.

The Bureau of Mines

Organization Now Conducting Eleven Experimental Stations

IN connection with the work of the Bureau of Mines, Department of the Interior, the bureau is now conducting eleven mining experiment stations, located in the various mining centers of the country, and bending their energies toward the special mining problems that are local to their part of the country. So great has been the demand for knowledge concerning the character of the work undertaken at these various mining stations and its general relation to the mining industry, the bureau has issued a bulletin describing the work of the stations.

Dr. Van H. Manning, director of the bureau, sketches the work of the different stations as follows:

"The station at Columbus, Ohio, situated at a clay-working center is employed mostly on ceramic problems. In this country there are about 4,000 firms manufacturing clay products, including brick, tile, sewer pipe, conduits, hollow blocks, architectural terra cotta, porcelain, earthenware, china, and art pottery. The amount invested in these industries is approximately \$375,000,000 and the value of the products exceeds \$208,000,000 annually.

"The station at Bartlesville, Okla., is investigating problems that arise in the proper utilization of oil and gas resources, such as elimination of waste of oil and natural gas, improvements in drilling and casing wells, prevention of water troubles at wells, and of waste in storing and refining petroleum, and the recovery of gasoline from natural gas.

"The Seattle station is busy with the beneficiation of the low-grade ores of the Northwest, and the mining and utilization of the coals of the Pacific States; the Tucson station is working on the beneficiation of low-grade copper ores; and the Berkeley station has shown how losses may be reduced at quicksilver plants and how methods at those plants can be improved.

"In the conduct of these investigations the bureau seeks and is obtaining the co-operation of the mine operators. At more than a dozen mills in the West engineers from the stations are working directly with the mill men on various problems, and the results they already have obtained more than warrant the existence of the stations. Success in solving the problem may easily be worth millions to the country. Mining men are using these stations more and more freely as they realize that the Government maintains these stations to help them, and that the difficulties of the operators, both large and small, will receive sympathetic consideration and such aid as the stations can give."

"What the Bureau of Mines has done for the great coal-mining industry, chiefly through investigations at the experiment station at Pittsburgh, Pa., has been published in numerous reports issued by the bureau.

Some of the more important accomplishments have been the development and introduction of permissible explosives for use in gaseous mines, the training of thousands of coal miners in mine-rescue and first-aid work, and the conducting of combustion investigations, aimed at increased efficiency in the burning of coal and the effective utilization of our vast deposits of lignite and low-grade coal.

"How vast are the deposits of low-grade ores being made available through the experiment stations is shown by the work assigned to the station at Minneapolis, Minn. The primary purpose of this station is to devise methods of utilizing low grade iron ores. It has been estimated that the reserves of low grade magnetic iron ores in the State of Minnesota alone amounts to some forty billion tons, but until recently these ores have been untouched because no process of treating them profitably has been devised. Even now only one company is attempting to utilize them. The Minneapolis station has already demonstrated that one process for utilizing the great deposits of manganiferous iron ore on the Cuyuna Range is metallurgically possible.

"Work such as this not only stimulates mineral production and helps to make available tremendous resources that are now unused, but it increases the total wealth of the Nation and ultimately benefits every citizen.

"The mining industry is so related to commerce and manufacture that the importance of publishing the results of technical investigations of mining problems is becoming more and more evident. The miner and the mine operator are integral parts of the industrial system of the country, and each needs to keep in close touch with what the Government is doing through the mining experiment stations of the Bureau of Mines.

"In the West vast quantities of low-grade complex ores will become available as soon as commercially feasible processes are devised. Many of the problems involved, which are being attacked at the Golden, Colo., station, the Salt Lake City, Utah, station, the Seattle, Wash., station, the Tucson, Ariz., station, and the Berkeley, Calif., station, are of such a nature that the small operator cannot afford to attack them, and the large operator finds them outside his field. Yet the solution of any one of them may add greatly to the available resources of the country and may result in establishing a new industry that will build up the district in which it is situated. Already these stations, although young, have witnessed such results.

"Today, through the efforts of men at the Golden station there is an American radium industry. Formerly the low-grade radium-bearing ore was wasted, the best of the ore was bought by foreign concerns at ruinously low prices, and the radium was shipped back to this country at excessively high prices.

"The Salt Lake City station has devised novel methods of treating certain low-grade and complex

ores of lead and zinc. These methods show a large saving of metal over methods hitherto employed, and have made available ores that other methods could not treat profitably.

Concerning Wood Alcohol

Even Chemists Find Determination Difficult at Times

DR. REID HUNT, head of the Department of Pharmacology of the Medical School of Harvard University, and at one time head of the Division of Pharmacology of the United States Health Service, has prepared a bulletin for the American Chemical Society on the subject of wood alcohol.

In part the bulletin reads as follows:—

"Many consumers and perhaps some of those who sell drinks seem to think that wood alcohol has such characteristic properties that its presence can be readily detected by the odor or taste. On the other hand, those who make such drinks know that this is not the case, but either believe that the poisonous action has been exaggerated or that the chances of detection are relatively slight.

"Moreover, testimony was offered in a court a number of years ago to the effect that the manufacturers of flavoring extracts had been approached by dealers in wood alcohol and urged to make their preparations with it. The fact that already at that time the bottles bore the label 'poison' was explained as a ruse to prevent the Government from placing an internal revenue tax upon wood alcohol.

"It cannot be too strongly emphasized that there is not a single property of wood alcohol, except its poisonous effects, which any one but a chemist can distinguish between purified wood and ordinary 'grain' alcohol. The appearance, odor, and taste of the two are so strikingly alike that even chemists who have had much experience with them are unable by these properties to distinguish between them with certainty. The difficulty is, of course, greatly increased when essences, flavors, or coloring matter are added, as is the case in the spurious drinks now being offered for sale. Not only can the consumer, however great his familiarity with alcoholic beverages may be, not trust his own judgment in this matter, but he cannot trust the judgment of an experienced bar or saloon keeper.

"As regards the question of the poisonous properties of wood alcohol, it is inconceivable that any ordinary intelligent person can now be in doubt on this subject, in view of the hundreds of cases of death and blindness resulting from its use. Twenty years ago, when such cases first began to be reported, there was some reason for a little uncertainty on this subject not only on the part of the public, but of chemists and of those physicians who were not familiar with certain pharmacological experiments on dogs. The odor, taste, and other properties of pure wood

alcohol are 'so like those of ordinary alcohol that chemists were inclined to attribute the bad effects from the former to the presence of impurities in the commercial sampler. But none of the impurities in the latter are as poisonous or cause the same effects as the absolutely pure wood alcohol itself.

"Poisonousness is an inherent quality of wood alcohol. It is impossible to prepare non-poisonous wood alcohol as it is to prepare non-poisonous prussic acid."

Western Topping Plants

Government Bulletin Describes Several Californian Plants

THE Bureau of Mines, Department of the Interior, announces the publication of Bulletin 162, "Removal of the Lighter Hydrocarbons from Petroleum by Continuous Distillation as Practiced in California," by J. M. Wadsworth, petroleum engineer.

This bulletin describes the construction and operation of the type of continuous distillation plants commonly known as "topping" or "skimming" plants. Detailed descriptions are given on methods of constructing and operating a number of representative plants.

The topping industry is very important in California since the nature and uses of the oil render it necessary to utilize a cheap and rapid method for dehydrating and increasing the flash point of the oil to the extent that it can be utilized as fuel for the railroads and industrial plants. Topping plants are also made use of to a certain extent in conjunction with a complete refinery as they furnish a cheap and rapid means for removing the lighter fractions from the crude. Although many refiners in other fields have experienced considerably with various types of continuous stills, plants that are in a strict sense topping plants, are in general use only in California.

The bulletin contains data that will be of interest, not only to the man who operates a plant for removing the lighter fractions from crude oil, but to any one connected with the refining industry. Data is given for costs of plants, operating expenses, fuel consumption, heat losses, over all efficiency, laboratory tests on the distillates, temperatures of the liquids passing through the heat exchangers, analyses of the flue gases, etc. Particular attention is given to fuel economy and losses of heat since the relative efficiencies of different types of distilling apparatus are calculated by dividing the heat theoretically required by the heat content of the fuel consumed.

The plants studied handled about 2,300,000 barrels of crude monthly and produced approximately 400,000 barrels of tops, an average yield of 18%. The cost of the plants per barrel daily capacity varied from \$2.00 to \$28.55, total fuel consumed under the stills and boilers 1.07 to 3.69 per cent. of crude treated, and the combined efficiency of furnace and stills ranged from 34.8 to 66 per cent.

The author is convinced that the character of the oil and the extent to which the lighter fractions are to be removed govern to a large extent the process best suited. In many cases the conventional still will be more satisfactory than any of the pipe retorts.

Copies of this bulletin may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a cost of fifty cents each.

To Produce Peat Bricks

Plant at Estevan, Sask., Ready Next Summer
Says Report

REPORTS received from the Lignite Utilization Board by the Research Council of Canada indicate that a plant will be in operation near Estevan, Sask., in August, next, which will turn out 30,000 tons of briquettes per year, and these briquettes will sell for about \$9.40 per ton in Winnipeg.

A recommendation was also adopted by the Council that a careful and thorough survey of the oil shales of Canada should be under Dominion auspices.

The Council recommended also the establishment of a central bureau to collect and disseminate all possible information regarding all natural resources.

An associate committee of biologists was established to report on all biological problems affecting Canadian industry, and an associate committee is to be constituted of scientific men in Canada who are pre-eminent in their particular lines.

New Import Ruling

Imports Sufficient for Six Months' Needs
Permitted

NEW regulations governing importation of dyes, dyestuffs, and certain other commodities of non-enemy origin have been issued by the War Trade Board section of the Department of State. Effective December 19, 1919, and until further notice, no license for the importation into the United States of dyestuffs derived directly or indirectly from coal-tar products, including crude and intermediate products which are of non-enemy origin, will be issued except to satisfy the requirements of actual consumers for a period not exceeding six months from the date of the filing of the application.

Accordingly applications filed by actual consumers should be accompanied by an affidavit stating that the commodities and the quantities thereof applied for are required to satisfy the said six-months requirements and are not in excess thereof. Likewise, importers, jobbers and all other persons desiring to import dyes of non-enemy origin shall file with their applications affidavits signed by the ultimate consumers of the articles applied for stating that the commodities and quantities are not in excess of the amount required by them for actual consumption during the same period.

Oil Shale Research

Government and State of Colorado to Spend
\$10,000 This Year

D. R. VAN H. MANNING, Director of the Bureau of Mines of the Interior Department, announces that a co-operative agreement has been entered into between the Bureau of Mines and Governor Shoup of the State of Colorado, for the expenditure of the sum of \$10,000 under the direction of the Bureau of Mines on investigations of the oil shales of Colorado. This investigation is to be under the direction of Mr. Martin J. Garvin, Refinery Engineer of the Bureau of Mines, and is to be conducted at Boulder, Colo., where laboratory and office facilities will be furnished by the University of Colorado.

The investigation is for the purpose of providing fundamental data necessary in the development of commercial processes for the retorting of oil from the shale and the refining of crude shale oil. This investigation will supplement investigations previously made and now being conducted by the Bureau of Mines, and will result in placing before the public this fundamental information sooner than would be possible on the limited funds otherwise available to the Bureau of Mines. It is particularly important to the interests of the people of Colorado that information on oil shale be obtained in order to further the commercial development of this latent resource. The information will be given to the public from time to time as rapidly as it is developed.

Frank H. Nickle, manufacturer of agitator driving yokes, a standard power transmission device for driving agitator or stirrer shafts in open or closed chemical tanks, kettles and other containers, announces the organization of the Nickle Engineering Works with office and factory at 729 North Niagara street, Saginaw, Mich. The company will install additional machine shop equipment and increase the scope of operations.

Plans are being considered by the Canadian Advisory Council for Scientific and Industrial Research for the establishment of a plant near Vancouver, B. C., for the manufacture of alcohol from wood waste from sawmills. Dr. McCallum of the Council estimates that 50,000,000 gallons of alcohol can be made from the wood wasted in British Columbia.

H. E. Cleaves, formerly chemist with the Metal and Thermit Corporation, Jersey City, N. J., is with the Charleston Chemical Company, Charleston, W. Va., as chief chemist.

Arthur R. Cade, formerly instructor in chemistry at the University of Minnesota, Minneapolis, Minn., is now associated as research chemist with the National Carbon Company, of Fremont, Ohio.

Mr. J. A. Shrader, chemist of the Bureau of Plant Industry, of the Department of Agriculture, Washington, D. C., has resigned to become chief chemist of the Coconut Products, Inc., whose mills are located at Canton, near Baltimore, Md.,. The company expects to crush copra on a large scale.

Recent Chemical Patents

Copies of Specifications of These Patents May Be Obtained from the Commissioner of Patents, Washington

1,321,014—METHOD OF AND APPARATUS FOR APPLYING COATING. Herbert W. Day, Wollaston, Mass., assignor to Spray Engineering Co., Boston, Mass., a corporation of Massachusetts. Filed Sept. 8, 1919. Serial No. 322,539. Twenty-two claims.

1. Means for applying coating comprising means for maintaining a film of coating material, means for causing a motive agent to break through and discharge said film, and means to effect the transformation of the discharged film into a sheet for application as such to the surface to be coated or into a mass intermediate in cross section between that of a sheet and circular form.

1,321,026—COMBINATION FLASH-LIGHT AND TOILET ARTICLE. Adolph N. Freed and Oscar E. Freed, Rockport, Ill. Filed Feb. 28, 1919. Serial No. 279,707. Three claims.

1. A device of the character described comprising a casing provided in one end wall with an opening and having its front wall provided with an opening adjacent said end wall, an illuminating device within said casing adapted to project light through said openings, and a slide member within said casing formed as a pair of right angularly extending plates bearing against said end and side walls, said plate being provided with openings adapted to register with said first named openings whereby upon movement of said slide either of said first named openings may be covered or uncovered.

1,321,051—ROSIN-COLLECTOR. Jirobei Kamada, Tokyo Fu, Japan. Filed Feb. 16, 1918. Serial No. 217,730. Three claims.

1. A rosin collector including a supporting ring, means for attaching said ring to a tree, a flanged cover threaded in said ring and provided with a circular penetrating cutting edge, a receptacle cover communicating with the flanged cover, and a receptacle removably supported by said second mentioned cover.

1,321,063—METHOD AND APPARATUS FOR TESTING GASES. Arthur B. Lamb and Alfred T. Larson, U. S. Army. Filed Feb. 17, 1919. Serial No. 277,599. Thirty-eight claims.

1. In a method of quantitative determination of low concentrations of combustible gases, passing said gases over catalytic material in the vicinity of a thermo-junction.

1,321,064—METHOD AND APPARATUS FOR TESTING GASES. Arthur B. Lamb and Alfred T. Larson, U. S. Army. Filed Feb. 17, 1919. Serial No. 277,600. Twenty-four claims.

1. A method of quantitative determination of gases comprising changing the resistance of one of a pair of electrically heated wires by passing gas containing combustible material and free of eddies over said wire and measuring the change in resistance.

1,322,580. METHOD AND APPARATUS FOR PRODUCING QUINONE AND QUINOL. Frederick T. Kitchen, West New Brighton, N. Y., assignor by mesne assignments to K. & T. Chemical Corporation, New York, N. Y., a corporation of New York. Filed March 3, 1916. Serial No. 81,819. Renewed April 3, 1919. Serial No. 287,342. Twenty-seven claims.

6. A method of producing the product or products herein set forth, comprising introducing benzene into a suitable electrolyte of greater specific gravity than benzene, in such manner that it rises in the electrolyte, and passing an electric current through the electrolyte to produce oxygen to oxidize the benzene during its rise in the bath, the benzene being introduced in excess, so that the quinone formed may be dissolved by the benzene, and repeatedly subjecting the benzene solution to the electrolytic oxidation until the solution becomes high in concentration of quinone.

24. An apparatus of the character described, comprising an electrolytic tank, an electrode and means for introducing a substance of less specific gravity than the electrolyte into the lower part of the tank, whereby it may rise in the electrolyte to undergo treatment at one of the electrodes, a reducing tank, means for introducing a reducing agent therein, and means for introducing the treated substance into the lower part of said reducing tank, said reducing tank containing means for increasing the intimacy of contact between the introduced substance and the reducing agent.

1,322,607—CARCASS DEHAIRING AND CLEANING MACHINE. Arthur E. Ozouf, Chicago, Ill., assignor to Albright-Nell Co., a corporation of Illinois. Filed August 13, 1917. Serial No. 185,897. Ten claims.

1. In a machine of the class specified, stationary means for supporting carcasses, scraping mechanism acting therethrough against the gravity of the carcasses to dehair the carcasses, and means for advancing the carcasses past the scraping mechanism.

1,322,631. CELLULOID ARTICLE OF MANUFACTURE AND METHOD OF PRODUCING THE SAME. Henry Segall, New York, N. Y., assignor to Aaron Segall, New York, N. Y. Filed January 18, 1918. Serial No. 212,509. Thirteen claims.

1. A celluloid article of manufacture consisting of a celluloid body and a textile fabric so combined therewith with the celluloid and fabric are fused or amalgamated together in a complete union, to produce a body mass in which the fabric becomes an integral part of the celluloid mass and the composite union of the two elements produces a compound celluloid-textile body, substantially as and for the purpose set forth.

1,322,757—METHOD OF AND APPARATUS FOR PRODUCING AMMONIUM SULFATE. Henry A. Carpenter, Sewickley, Pa., assignor to Riter-Conley Manufacturing Co., Pittsburgh, Pa., a corporation of New Jersey. Filed February 15, 1916. Serial No. 78,444. Thirteen claims.

1. In the production of sulfate of ammonia by treating coal gas in an acid saturation bath, the method herein described of freeing the sulfate of acid, consisting in subjecting the sulfate to a cleansing liquid, with the latter and the sulfate moving in opposite directions during the cleansing process.

5. In apparatus for producing sulfate of ammonia, a saturator containing an acid bath adapted to receive coal gas and form ammonium sulfate, means for withdrawing the sulfate, and means for washing the sulfate as it is being withdrawn.

At the annual shareholders' meeting of the Badische Anilin und Soda-Fabrik there was considerable discussion about the proposal to move the headquarters of the corporation from Mannheim across the Rhine to Ludwigshafen. This proposal seemed to meet with general approval, but no definite decision was taken. A dividend of 12 per cent. was declared (as compared with 20 per cent. for the previous year). The management reported that the first ten months of 1918 had been quite satisfactory as far as the activity of the factory is concerned, but the income from sales had not kept pace with the increased costs of operations. The last two months of the year, however, brought disaster. In February, 1919, bonds to the extent of 50,000,000 marks (about \$11,900,000 at par) were issued by the Badische, the principal object of which was to provide funds for factory extension and improvement.

With the return of normal conditions, potash from wood ashes will not be commercially interesting, in the opinion of Mr. C. P. Winslow, a Chicago chemical manufacturer. The initial cost of a potash plant of twenty-four leachers, including the building in which they would be housed, according to Mr. Winslow, between three and four thousand dollars. The cost of manufacturing the potash, not including the cost of the wood ashes would vary from seven to seventeen cents a pound, depending upon the kind of ashes used and whether the plant was running at capacity or not.

Mainly About Companies

The Hoffman Chemical Company, of Quincy, Ill., has been incorporated with a capital of \$10,000. The company will manufacture hand cleaner. The company's offices are at 331 Hampshire avenue.

The Kentucky Chemical and Color Company is being formed in Louisville, Ky., with a capital of \$70,000, to manufacture coloring products for paints and varnishes, sprays and general insecticides.

The Colonial Chemical Company has been incorporated in Delaware with a capital of \$50,000.

Service Laboratories, Inc., of Brooklyn, drugs and chemicals, has been incorporated by N. Buell, F. G. Hoyt, G. H. Fein, 148 Penn. Street, Brooklyn.

R. & Z. Corporation of Brooklyn, chemicals, has been incorporated by C. and S. Rubin and T. Zimmerman, 766 East 2d Street, Brooklyn.

Lu-Pe-Do Sales Corporation, of Buffalo, makers of lubricants, has been incorporated by M. J. Van Aernam, J. N. Souders, H. A. Zimmerman, Buffalo.

Reading Extract Company has been incorporated in Delaware with a capital of \$100,000. Incorporators: Lawrence C. Briggs, Dr. Rudolph Pabeska, Reading, Pa., and W. A. Baer, East Greenville, Pa.

Adelphi Paint and Color Works, Inc., of Manhattan, has been incorporated with a capital of \$80,000 by A. Levin, A. Shinske, D. F. Price, 11 Nicholas Avenue, Brooklyn.

Mme. Myale, Inc., drugs, chemicals, etc., has been incorporated under the laws of New York, with a capital of \$150,000. Incorporators: J. J. Leahy, Jr., E. B. Myers, R. McCord, 59 Wall Street.

United Vegetable Oil Refinery, Inc., of Brooklyn, has been formed with 700 shares preferred stock, \$100 each; 1,000 shares common stock no par value; active capital, \$80,000; S. W. Stevens, Jr., W. D. Kay, L. J. Ellinger, Hotel Chatham, incorporators.

Standard Wax & Import Company of Manhattan has been incorporated with 3,000 shares common stock, no par value; active capital, \$30,000. Incorporators: J. G. Roberts, G. B. Heath, I. J. Nichols, 115 Broadway.

Alfred Joennsson Company, of Manhattan, N. Y., drugs and chemicals, has been incorporated with a capital of \$1,000,000.

The Western Delaware Chemical Company has been incorporated in Delaware with a capital of \$1,000,000. The incorporators are W. A. Stephens, L. A. Brown, John W. Anderson, all of Detroit, Mich.

Carmen Supply Co., Inc., of Manhattan, bleaching powder, alkalis and chemicals, has been incorporated under the laws of New York with 260 shares preferred stocks, \$100 each; 1,000 shares common stock, to par value; active capital \$75,000. A. L. Becker, J. J. Franc, Y. E. Sheer, 60 Broadway.

Construction

Prominent interests connected with the Kiso Iron Works, of Japan, are contemplating the establishment of a cement manufacturing company, to be capitalized at 2,000,000 yen (\$997,000). The production of the factory is estimated to be 20,000 barrels of cement per month. Machinery which has been ordered from an American company is due to arrive in March of next year.

The Lipps Brewing Company of Peoria, Ill., is converting its brewery into a vegetable oil refinery, hydrogenation and lard substitute plant.

Dyes will be produced by a plant to be erected in Newark, N. J., at 235-245 Elizabeth Avenue, by Mr. Leo Schwalb. Mr. Abraham Jacobson will be manager. About two hundred hands will be employed.

The W. G. Cleveland Drug and Surgical Company, of St. Louis, has leased for a period of ten years, the four-story and basement building at 1109 Locust street, opposite the present quarters of the company.

The Union Seed and Fertilizer Company, of Memphis, Tenn., has begun construction of one of the largest crude cotton seed oil mills in the South. The company will have also one of the largest and most complete chemical plants in the country attached to its mills, although its primary product will be cotton seed oil.

The Texas Chemical Company with offices in the Scanlan Bldg., Houston, Texas, have begun the construction at Manchester, Texas, of a \$500,000 plant which will have when completed a daily output of 100 tons of sulphuric acid. The new plant will be in operation in May, .

The Universal Packing Company, Fresno, Cal., has sold its plant to the California Products Company. The factory will be converted for the manufacture of vegetable oil products.

The Southern Agricultural Chemical Company, Atlanta, Ga., has acquired a site for a large plant to be erected near that city.

The Columbia Graphophone Manufacturing Company will spend \$3,600,000 on a new plant to be erected in Baltimore, Md. The new plant is to be completed by midsummer, 1920.

Nitro, W. Va., was eventually sold to the Charleston Development Co. for \$8,551,000. The new owners will maintain the town intact and intend establishing within its limits a number of industries. Nitro was built by the War Department at a cost of about \$70,000,000. Completion of the town was cut short by the signing of the armistice and manufacture of explosives was never started.

The plant of the Corn Products Refining Co. at Edgewater, N. J., was compelled to suspend operations for several days during the week of October 27 on account of the longshoremen's strike in New York. Three-quarters of a million bushels of corn were aboard boats lying in New York harbor at one time.

The plant of Clark Bros.' Lamp Company in Trenton, N. J., has been purchased by the Union Casein Co., of Philadelphia, and the National Waste Co., of Philadelphia and St. Paul. The price was \$45,000. The new owners will manufacture paints.

The Oliver Continuous Filter Co. has removed its office from 299 Madison avenue to 33 W. 42nd street, New York City.

The newly erected graphite factory of Skaland Grafteverk vid Senjen, near Tromsø, Norway, is now ready to commence operations. It is stated that the ore deposits near the factory contain over 20 per cent. of pure graphite. The capacity of the new plant will be about 3,500 tons of graphite per year.

The Acme White Lead and Color Works, Detroit, Mich., have awarded a contract for the building of a four-story plant at Hamtramck, Mich.

Financial

The United States Industrial Alcohol Company has declared its regular quarterly dividend of $1\frac{1}{4}$ per cent. on its preferred stock.

John Lucas & Co., Philadelphia, have purchased the entire capital stock of W. W. Lawrence & Co., paint manufacturers, for \$500,000. The Lawrence Company did a business of \$1,250,000 a year. The company will be continued as a separate organization by its new owners.

The Virginia-Carolina Chemical Company has declared the regular quarterly dividend of 2 per cent. on the preferred stock payable January 15 and the regular quarterly dividend of 1 per cent. per share on the common stock, payable February 2.

Industrial Notes

The Massachusetts Institute of Technology is understood to be considering a plan whereby members of the institution's teaching staff may be retained by various industries as consultants. This step is being taken in order that the income of the staff may be increased.

Two investigators, representing the dye and chemical group of the American Chamber of Commerce in London are now in Austria and Germany in order to make a study of German methods of production and distribution.

In a special dispatch to the New York Times, Sir Ernest Rutherford, the English physicist, denied that he had discovered a method of transmuting the elements.

The Federal Trade Commission has cited the Sunbeam Chemical Company, Inc., of Chicago, a corporation engaged in the manufacture and sale of dye soaps, alleging unfair methods of competition. The corporation has been given forty days in which to reply.

Mainly About Chemists

Mr. Ben H. Nicole, formerly at the Mellon Institute, University of Pittsburgh, Pittsburgh, Pa., working on various industrial fellowships and later connected with the Chemical Warfare Service laboratory in Paris, where he had charge of the work along organic chemical lines, with the rank of captain, has become assistant professor of chemistry at the University of Chicago, Chicago, Ill.

Dr. Louis E. Wise has severed his connections with E. I. du Pont de Nemours and Company, where he held a research position at their Jackson Laboratory, Wilmington, Del., and has accepted the position of professor of forest chemistry in charge of the department of forest chemistry at the New York State College of Forestry, Syracuse, N. Y.

Professor Grinnell Jones has severed his active connection with the Tariff Commission in order to resume his duties as a member of the faculty of Harvard University, Cambridge, Mass. He is still retained, however, on the staff of the Tariff Commission in a consulting capacity.

Mr. Peter G. Pirrie, who has for some years past been active in the baking and milling industry as a chemical engineer, and recently on the staff of the Siebel Institute of Technology of Chicago, has accepted the position of chief of the trade and service laboratories of the American Institute of Baking at Minneapolis, and will also act as associate instructor on the staff of the Wm. Hood Dunwoody Industrial Institute of that city.

Mr. R. K. Brodie has been transferred from the position of industrial fellow at the Mellon Institute of Industrial Research to the chemical department of the chemical division of Proctor and Gamble Company, Ivorydale, Ohio.

Mr. M. Landon has left the employ of the Koppers Company of Pittsburgh, where he was employed as a benzol operating engineer, supervising the starting of benzol plants built by them, and has become operating superintendent of the Columbian Carbon Company's gasoline absorption plant, Smithton, W. Va.

Mr. Harold Gray, who has been on the research staff of Eli & Company of Indianapolis, Ind., for the past four years, is now on the research staff of B. F. Goodrich Co., Akron, Ohio, in the organic development department.

Mr. Robert G. Dort recently left the engineering division of the U. S. Air Service to take a technical position with the Standard Textile Products Company, New York City.

Thurston V. V. Ely, for several years with H. R. Lathrop & Co., Inc., of this city, as manager of their drug department, has resigned his position with them to go with Charles T. Howe, 299 Broadway, this city, January 1.

Mr. Robert S. Bly, formerly in the Chemical Warfare Service and later in the laboratories of the Florida Wood Products Company, of Jacksonville, Fla., as research chemist, is at present in the chemistry department of Northwestern University, Evanston, Ill., assisting and doing work under Professor Lewis for the Ph.D. degree.

V. A. Scully, 1765 Broadway, has been appointed New York representative of the Kelso Manufacturing Company, a New Jersey corporation manufacturing asbestos.

William J. Cotton, formerly with the color laboratory of the Bureau of Chemistry, Washington, D. C., is now with the research division of the National Aniline and Chemical Company, Buffalo, N. Y.

J. A. Le Clerc, formerly chemist in charge of the laboratory of plant chemistry of the Bureau of Chemistry, Washington, D. C., is now with the Miner-Hillard Milling Company, of Wilkes-Barre, Pa.

New Laboratory Apparatus

After exhaustive experimental work, the "MacMichael Universal" Viscosimeter, an instrument capable of testing the viscosity of any fluid within the range of ether to asphalt, has been developed. This instrument was first put on exhibition at the thirty-sixth annual convention of Official Agricultural Chemists at Washington, D. C., and was received with enthusiasm by the chemists at this convention. Dr. Brovenor of New York has made extensive tests on the "MacMichael Universal" and has pronounced it a scientific instrument of the same relative importance to the chemist doing viscosity work as is the analytical balance.

The Hortvet Cryoscope, a new freezing-point determination apparatus, was also first put on public exhibition at the thirty-sixth annual convention of Official Agricultural Chemists. Dr. Julius Hortvet of the Minnesota State Dairy and Food Commission, the man responsible for this new apparatus, read a paper before the convention dealing with the application of this instrument to the determination of the percentage of water in milk. Dr. Hortvet's paper is embodied in the official report of this meeting.

The Juerst Ebulliometer is an instrument equipped with an especially designed thermometer and a set of convergent tables, which enable an unskilled operator to make alcoholic determination on cereal beverages, beers and light wines where the amount of alcohol present does not exceed seven per cent. The application of the juerst is not confined to alcoholic determinations, but can be used for the determinations of the boiling-point of any liquid.

Of special interest to chemists and physicists engaged in doing high vacuum work is the set of America rotary high vacuum pumps, which are capable of producing an almost perfect vacuum—.00001 inch. These pumps have the unusually high capacity for a rotary pump of 5 cu. ft. per minute. The power consumption is relatively small and, unlike the rotary pumps previously put on the market, these are not laboratory toys, but are built for continuous operations 24 hours a day and 365 days a year. These pumps are mechanically indestructible, and unaffected by gases and conditions usually prevalent in a chemical laboratory.

The United States Civil Service Commission announces an open competitive examination for junior gas chemist.

POSITION VACANT.

SALESMAN WANTED—Experienced in glass tubing, laboratory glassware, scientific apparatus and specialties by a large manufacturing company. State full particulars regarding experience, firms with whom you have worked, salary expected, etc. Address **THE CHEMICAL ENGINEER**, Box 1201.

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The Paper Situation.

IN view of the present conditions prevailing in the American paper industry, the recent review of America's resources of spruce, hemlock and fir, the principal woods from which newsprint paper is made, prepared by the Forest Service of the Department of Agriculture is of peculiar interest. According to the estimates given in this report, in less than twenty years 95 per cent. of the pulp and paper mills, especially those located in the East, will have exhausted their supplies of raw materials.

The annual cutting of these woods in New England States and New York is about 3,262,000 cords. At this rate, the supply will last about seventeen years. In the Lake States the annual cutting is slightly less—3,030,000 cords. Here the supply at this rate will be exhausted in eighteen years.

Maryland, Virginia and North Carolina, according to the Forest Service, are even worse off. If 1,470,000 cords are cut annually in these states the available supplies of spruce, hemlock and fir will last about ten years. It is only in Washington, Oregon, Alaska and California that the wood resources are in no danger of early exhaustion.

In brief, making all possible allowances for all available supplies at the present rate of cutting, the supply of these woods in the United States will be sufficient to meet the lumber and paper demands of the United States for less than three-quarters of a century.

But, unfortunately for the paper industry of this country, mills cannot be economically moved so as to be near the largest available supply of wood.

The greater part of the country's reserve supply of wood lies in the Western States, and the majority of the mills in the East. It is neither economically possible to move the mills or to bring the raw material they use from the forests of the West.

The Forest Service of the Department of Agriculture is apparently of the opinion that the paper mills of this country, to provide themselves with an adequate supply of raw materials in the near future, must depend to an ever greater extent than heretofore upon the Canadian sources of supply or must attempt to utilize to a far greater extent the forest resources of the West. Of all the paper wood and pulp now used by the United States about one-third comes from Canada.

So far as the supply of newsprint paper is concerned a very large percentage of America's supply comes from the Canadian mills.

Canada's wood resources are not as readily available to American manufacturers as they would like them to be. The various provincial governments, notably Quebec and Ontario, have for some years past placed certain restrictions on the export of pulpwood from crown lands, which have had the effect of forcing pulp and paper manufacturers to locate their plants in Canada. The success of this policy from the Canadian standpoint is apparent from the fact that there are at present approximately ninety pulp and paper mills in Canada, producing about 2,100 tons of paper daily, of which 89 per cent. is available for export. This policy, it is the intention of Quebec at least, to hold to in the future if a statement made by Sir Lomer Gouin, the premier of the Province, at the recent annual dinner of the Canadian Pulp and Paper Association, may be credited. For while Senator Underwood has introduced a motion to the United States Senate asking permission to attempt to open negotiations with the Canadian Government regarding the importation of paper and pulp from Canada into the United States, Sir Lomer gave the supporters of the Senator's plans little cause for optimism. He made it quite plain that the Quebec Government had no intention of changing its present policy.

If the paper industry of the United States is also to depend upon Canada to an increasingly extent for its newsprint, it will be forced, it seems, to buy Canadian newsprint and hope for little in the direction of larger imports of pulp wood from Canada.

Outside of Canada, the only other alternative source of supply for the paper industry of this country apparently lies in the West. According to va-

rious authorities, in spite of high freight rates and high wages, there are a number of reasons why the forests of the West should be considered as a source of supply. There are, first of all, large quantities of wood available in the West at a lower stumpage charge than is obtainable in the Northeastern States. Further, there is a great deal of wood available on national forest reserves. Then, too, the yield per acre of the Western forests is greater than in the Eastern Canadian forests.

But which of these two sources of supply of the American paper making and using interests eventually are forced to fall back upon, the fact remains that the United States must adopt as a permanent policy a thorough-going determination to eliminate all waste whether in the forest, in handling of the wood or in the making of the paper. The policy of wastefully cutting down forests and making no provision for future growth must be abandoned. Every effort should be made in the future to foster the growth of the trees needed for the future purposes of the American pulp and paper industry. As in Sweden and a number of the European countries, the pulp and paper companies must employ skilled foresters whose work it will be to see that cutting is done in such a way that provision is made for future needs. Perhaps in this direction we may see the business of growing pulpwood become an industry second only in size to some of our larger industries.

But while too much emphasis cannot be placed on the necessity for the adoption of a proper policy of reforestation, almost equal emphasis should be laid on the necessity for the elimination of all wood waste, wherever it may occur. Mill waste, including slabs and edgings, can be used in paper making. It is estimated that about 1,600,000 cords of wood are wasted in this direction annually in the United States. Could this material be even partially utilized in the paper-making industry, it would contribute no small item to the general production.

The truly amazing growth of the pulp and paper industry of this country and of Canada during the past ten years, a growth founded upon a phenomenal increase in the number of ways in which paper and paper products are being used today in all industries, is some indication of the essential part paper plays in our national economy. If the estimates made by the Forest Service of the Department of Agriculture are appreciated at their true worth, it is apparent that the basis of our gigantic paper industry—the forests—is threatened with extinction. The way to save them has been indicated and there is every reason to believe that the more progressive pulp and paper companies of the United States will adopt the policy of economy and conservation outlined above it. The sooner such a policy becomes the policy of all, the better for the paper industry of the United States.

Advertising to Labor.

N an effort to understand the causes of industrial unrest, Mr. Whiting Williams, director of personnel of the Hydraulic Pressed Steel Company of Cleveland, left his desk and spent seven months as a laborer in the steel mills and coal mines. Telling of his experiences the other day, Mr. Williams accounts for industrial unrest by naming four principal causes. These are, in his opinion:

"The pre-eminent importance of holding a job; the terrible danger of being forced into joblessness; the unholy alliance between tiredness and temper, between fatigue of body and mind, which gives opportunity for agitators to work upon the feelings and sensibilities of the worker, and the almost complete ignorance of the average worker as to the plans, purposes and ideals of his employer."

While Mr. Williams' statement will, perhaps, be ridiculed by various aspirants to political office, who seem to believe that the surest road to success is one built of stones cast at the honesty and Americanism of a certain section of their fellow citizens, most American business men know that, excluding a portion of the foreign born, the labor men of this country are not "Reds" in the common acceptance of the term and have no real sympathy with "Red" propaganda. As Mr. Williams points out the difficulties of a trying period of readjustment have, it must be acknowledged, made them prone to listen to the promptings of the Extremists among the labor agitators with which this country is—alas!—somewhat too well supplied.

If we may believe Mr. Williams, the "Red" agitators are making the most of an exceptional opportunity, an opportunity which rests purely and simply upon ignorance on the part of the average workingman of the character and purposes of his employer, whether that employer be individual or corporation.

So far as this phase of the relations between capital and labor is concerned, the difficulties of the situation call for no exaggeration. They are great, indeed. In the olden days, when it was possible for the proprietor of a plant to know everyone of his workmen and for every one of his workmen to know him, there were far less chance for a misunderstanding than there is today. Personal contact is today out of the question. But the problem implicit in Mr. Williams' analysis of the situation so far as the mines and steel mills are concerned, is not to be considered insoluble for that reason.

We are inclined to believe that the average manufacturer has neglected to keep his workmen in contact with the purposes of the industry of which he forms a part; he has failed to follow the lead of such organizations as the Standard Oil Company, the Proctor & Gamble Company and the Eastman Kodak Company, and continues to regard his business, at least so far as his employes are concerned, as of interest to himself alone. He tends to forget, even at this late date, that increased production can

best be obtained from contented, interested workmen, and this "interest" is easiest gained by making the individual working man feel that he is an essential part of the organization from which he draws his wages.

That is why one cannot help but feel that there was a great deal of common sense in what one Sherman Rogers, a laboring man, told the Sphinx Club in Baltimore the other day. He said in effect that labor is only too ready to listen to explanations of the problems of business and economics, and that the reason the worker is inclined toward radicalism is because the radicals have taken very much more pains than the conservatives to spread their views abroad. Of about three hundred strikes in effect at the time Mr. Rogers spoke, nine-tenths were "walk-outs" unauthorized by the American Federation of Labor. Practically all of them were engineered by a comparatively small body of agitators bent upon discrediting by all means in their power the present industrial regime.

Most American business men are today fully persuaded of the usefulness of publicity and advertising; to many an American business advertising is as essential as the power that drives the electric motors. This being true, it is all the more strange that many manufacturers are "sitting tight," as it were, and allowing "Red" agitators to beat them at their own game. They can sell goods by means of the printed word, but it never seems to have struck them that they can "sell" themselves to their workmen in the same way. The "Red" agitators are using all the resources of the spoken and printed word to vilify them, but do nothing in return. Need we ask whether American manufacturers have so little faith themselves in the present state of affairs that they will let American democracy go undefended?

Fuel Oil in Britain.

THE use of fuel oil in Great Britain has been very extensive. Experiments were first started by the British Admiralty in 1866 and these have continued ever since. The accumulation of data on the subject of oil fuel is therefore very complete on both the scientific and practical sides.

The British Navy in 1898 used oil fuel successfully on the destroyer "Surley." In 1906 it equipped at least twelve destroyers with oil firing for a designed speed of 38 knots per hour, and so successful were the performances of these ships that since that date every destroyer and light craft has been fitted for oil burning exclusively.

The British Admiralty has tried out various appliances for burning fuel oil made in Great Britain, Germany and the United States. As a result of these tests, apparatus designed and built in Great Britain was adopted by the Admiralty. The system

now generally used in Great Britain gives the following average results:

Weight of oil burned per hour.....	932 lbs.
Weight of water evaporated per hour....	13,050 lbs.
Weight of water evaporated per lb. of oil burnt	14.00 lbs.
Equivalent evaporation from and at 212 F.	15.91 lbs.
Equivalent evaporation from and at 212 F. per sq. ft. of heating surface per hour	10.92 lbs.
Thermal efficiency of boiler.....	82.3 per cent.

The advantages of oil fuel may be summarized as follows:

1. It is lighter than coal in proportion to its heat value.
2. It is more readily handled and cheaply stored.
3. It reduces greatly boiler house labor costs.
4. It promotes cleanliness in the boiler room.
5. It saves flue cleaning.
6. The relative value of these various advantages will, of course, vary according to circumstances, but these variations should not present any difficulty where the facts involved are known.

The method of comparing the costs of coal and oil firing is simple. At the outset it may be stated that there is no great difficulty nor expense involved in converting water tube boilers for oil fires. Further, it is possible to fit boilers so that either system may be used at short notice.

To make a comparative study of costs, first it is necessary to know the thermal value of each fuel, the cost per ton of each fuel, and, last but not least, the efficiency of each type of furnace. The first of these two factors demands little or no explanation beyond the expression of the hope that the time will come when all purchasers of coal or fuel oil will demand a certificate guaranteeing its thermal value.

So far as boiler efficiency is concerned, it may be briefly described by the number of British thermal units transferred to the water in the boiler for every hundred B. T. U. in the fuel fed. In good boiler practice the average efficiency is about 70 per cent. According to British authorities, the efficiency of a good oil fire burner should be 85 per cent. The difference is wholly due to the fact that an oil burner more perfectly fulfills the conditions chemically required for combustion than a normal grate.

Education's Drive for Funds.

A TOTAL of more than \$200,000,000 is being sought by seventy-five colleges located in different parts of the United States in campaigns to gather funds to increase their endowments.

Five of the largest institutions of learning in the country—Harvard, Princeton, Cornell, Northwestern and New York University—are busy with campaigns. The total sought by these five universities alone is about \$70,700,000. Northwestern asks \$25,000,000; Harvard, \$15,250,000; Cornell, \$10,000,000;

Princeton, \$14,000,000, and New York University, \$16,400,000.

Sums sought by the smaller and specialized institutions range from the \$8,000,000 sought by the Massachusetts Institute of Technology to the \$10,000 Fordham University wants to enable it to erect a memorial to its graduates who perished in the war.

A number of the women's colleges, including Mount Holyoke, Smith College and Bryn Mawr are also conducting campaigns.

Three of the institutions conducting the most elaborate campaigns have already received large sums under the terms of the will of the late Henry C. Frick. To Princeton, Mr. Frick left \$10,000,000; to Harvard, \$5,000,000, and to the Massachusetts Institute of Technology another \$5,000,000. Massachusetts "Tech" has also received promises from T. Coleman Du Pont of large sums on conditions that certain other sums be subscribed by others during the campaign.

Northwestern University in Chicago intends conducting a campaign for \$25,000,000, to include \$10,000,000 for new buildings, an endowment fund for the maintenance of these buildings, an \$11,000,000 fund to provide for expansion of work, and the balance, \$4,000,000, to be used in carrying on the present work of the university. Out of this fund, Northwestern will also provide for an increase in salaries paid to its teaching staff. The University of Pittsburgh is also conducting a campaign for \$16,000,000. This sum is to be raised \$1,500,000 this year and \$1,000,000 each year thereafter until the full sum is collected.

Harvard has already collected \$12,000,000. Just as soon as the total amount sought (\$15,250,000) is obtained, an increase of 30 per cent. will be made in the pay of all professors. As an increase of 20 per cent. has already been granted, the total increase before the close of the year will amount to 50 per cent. Additions to the staff of the Department of Chemistry will use up the income of \$1,000,000 and another million will provide for new chemical laboratories.

So far as Princeton is concerned, to the end of January the subscriptions amounted to \$4,600,000, or about 30 per cent. of the \$14,000,000 fund being raised. It is the intention of the university authorities to use the money in various ways, but at least \$2,000,000 will be set aside to cover immediate increases in the pay of the present teaching staff.

Cornell University begins its \$10,000,000 campaign this month. Half of this sum is to be used as a general endowment fund and the other half will be used to increase the pay of its professors.

Barnard College, the Women's College associated with Columbia University, will also open a campaign for \$500,000 this month, as will New York University for a sum of \$6,450,000.

The country is apparently at last awakening to the seriousness of the situation in which the institutions of higher learning have recently found themselves. If the success which have rewarded the efforts of those behind the campaigns already under way may be accepted as any criterion, the response on the part of alumni and public will be enthusiastic and adequate in all cases.

Price Fluctuations in 1919.

PRICE fluctuations in the drug and chemical markets during the year 1919 were almost as spectacular as those which affected prices on the New York Stock Exchange. While this year we may perhaps reasonably expect somewhat lower prices in some directions, it is possible to be too sanguine in this direction, as higher costs will keep prices permanently far above their pre-war level. It is hardly likely that the American drug and chemical markets will again see fluctuations of the size apparent during the last year or two and as a matter of history it is interesting to note the changes in prices that affected a number of important chemicals. The fluctuation in the price of mercury during 1919 ranged from \$115 a flask in January to \$77 in May and \$90 in December. Antipyrin, a medicine derived from the benzene group of coal tar derivatives, which sold at around \$1 before the war, went during the year from \$1 a pound to \$5.40 at the year end. Salol, another coal tar product, used for a much similar purpose, the breaking of colds and fevers, declined from \$1.55 to 75 cents.

The industry of several American manufacturers has, however, brought down the price of two pharmaceuticals, much used in this country, aspirin and phenacetine, until they are now not far from the pre-war level. During the course of the war phenacetine sold at about \$9.50 a pound and aspirin at \$2. Both now sell in liberal quantities around 95 cents. The range of prices of some other chemicals is shown concisely in the following tabulation:

Quinine	\$1.00 to	\$1.25 an ounce.
Glycerin	.50 to	.23 an ounce.
Resorcin	7.75 to	6.00 an ounce.
Bromides	2.00 to	.55 an ounce.
Menthol	7.00 to	13.50 a pound.
Aniline Oil	1.15 to	.60 a pound.
Benzaldehyde	3.00 to	.75
Benzylchloride	2.25 to	.26

The celluloid industry in Japan is of recent development, having barely passed a decade since it was started in Sakai. To-day there are three factories producing celluloid sheets on a large scale located in the Kansai district, two of which are in the Prefecture of Osaka, and there are numerous factories all over the country making celluloid goods, which use the materials produced in the three large factories. It is only recently that celluloid was considered an important export.

An abstract of a paper dealing with Oil Shales, which appeared in the January issue of *The Chemical Engineer*, was printed without credit to Dr. Charles Baskerville, the author. The mistake on our part was quite unintentional and we are glad to make this correction.

Patenting and Promoting Inventions

The Value of an Invention Can Be Estimated Only After a Careful Survey Has Been Made of the Market It Is Designed to Supply. Such a Survey Is as Indispensable as an Investigation of Its Technical Character.

By **MOIS H. AVRAM**

President, Avram, Slocum and Avram

THE patenting and promoting of inventions is rather a devious subject and opens wide fields of conjecture. It presents so many different angles and ramifications, and plays such a vital part in the fundamental elements of industry, and upon which industry is dependent in a large measure for its success or failure, that the subject cannot begin to be covered briefly in the space allotted us here.

I wonder if any of you have ever stopped to reason how dependent are the articles you advertise on their basic patents. If the average laymen, who are not immediately concerned with this department of industry, are any criterion, the percentage is very small. The reason is obvious, as is also the reason why advertising as a profession and science was so long in becoming recognized in its rightful importance to industry. Your contact has been chiefly with the finished product, the result of production and not with the intricacies necessary to bring those articles to a marketable state. This has also been true of advertising in that the public, and the manufacturer alike, have been in contact only with the finished advertisement as it appears and not with the multitude of details, the consummate science of planning and investigation, art and literature and study of markets and distribution, all of which have necessarily been applied prior to the launching of an advertising campaign. Advertising is no longer a hit-or-miss proposition—it is scientifically conducted and executed along previously determined and experience proven lines. An advertising campaign may deviate at times as to details, due to circumstances that could not be foreseen, but in its fundamentals the pre-determined line is followed unwaveringly toward success.

Advertising men, know all these things far better than I do. I simply mention them to show you how in this respect advertising has surpassed its natural parent industry. Industry, in all its branches, despite all claims to the contrary, is to all intents and purposes conducted on a hit-or-miss basis and those of them that have achieved or are achieving so-called success are doing so not because they have been planned correctly, but in spite of the lack of it.

I am going to make a statement, and I say it with no attempt at phrase mongering or idle chatter. A large percentage of manufacturing and industrial concerns in the country are operating at a loss. I don't want this statement to be misconstrued, however. When I say that, I mean that a large percentage of them, while making money and paying

dividends, are not anywhere near earning the returns possible for them to earn; others are failing to profit commensurate with the money represented in the investment necessitated for initial development and production; while some are engaged in the manufacture of articles which, while meritorious, are withheld from success due to improper management; and yet others represent articles which, while in themselves, are meritorious, have no place in public demand and small possibility of any adequate demand being created. These should never have been attempted. All of these irrespective of the reason represent an appalling loss and waste of money, time, energy, and materials, to the economic structure of the nation and almost without exception the reason can be found in failure to properly investigate a plan prior to beginning development.

Now, let us consider more carefully the relation which patent promotion holds toward successful industrial progress. Every week there are on the average 1,500 patents granted by the Patent Office at Washington. These by no means comprise the total of applications submitted. Over twice this number of refusals are part of the weekly routine of the department. To date, the Patent Office has issued almost 2,000,000 patents, and it is quite safe to approximate that not more than 10 per cent. of this vast number have ever truly seen the light of day. A far smaller percentage have reached the market as commercial successes. When it is considered that every one of these applications, whether allowed or not, represents an outlay of money, often to considerable amount, and that millions upon millions of dollars have been and still are being spent upon the development of these abortive projects, how tremendous is the waste that can readily be computed.

While I am in no sense a patent attorney, my professional capacity naturally brings me into contact with the developments of industries, from their inception and during their various stages from the time when they represent but an idea or a working model of a machine or device and through the various steps of development to manufacture and production for the market of the finished article. I, therefore, have been in a particularly strategic position to appreciate the necessity for proper procedure in obtaining protection for, and developing patented ideas. As a consequence, I have always employed when the necessity required the very best legal talent available in making patent searches to

insure their protection and their commercial success.

Bearing in mind that not more than one invention out of every thousand brings profit to its sponsors, we can realize how necessary it is to exercise extreme care in both regards.

It is far from my desire to discourage inventive endeavor, for in this we have the very essence of industrial progress. We must, however, face the cold fact that millions of dollars are squandered annually on inventions, and scores of careers blighted in the process. With expert and unprejudiced advice available, much of this money would not have been lost, and many inventions which end in utter failure would take their rightful place in the industrial world as departures of improvements of pronounced mechanical reliability and usefulness. Hence the only safe beginning for any invented device is to thoroughly investigate its possibility prior even to obtaining a patent. Such investigation should comprise roughly, the following factors:

The First Steps.

1. Investigation to determine its patentability with special reference to the prior art in similar devices and to avoid all possibility of infringement. We are all familiar with products which, because of infringement or improper patent protection or practice, have been forced to be withdrawn from the market after hundreds of thousands of dollars had been spent on development.

2. Thorough investigation of the model to prove its mechanical reliability and to assure the sponsors that it can be made commercially valuable.

3. Investigation of the market possibilities, to ascertain the presence of a demand for such a device or product and whether or not such demand may be created.

4. With these facts scientifically determined, as they can and are being determined for products every day, it is then definitely known whether or not the product can be made a commercial success. If not, the project should at once be dropped without further investment instead of proceeding blind-folded and nine-tenths of our industries are proceeding today. If the possibilities for success are assured scientifically, planned development should then be undertaken, the end to be attained being the beginning of the product to a commercially valuable form with the least possible delay and with the elimination of all experiment. The end to be achieved would have been previously determined and as the art of mechanical science is now exact no wastage would be met through blind-folded experiment.

5. Under these methods, the speculative element is practically eliminated from all inventive development. When production is begun we have reasonable assurance that our efforts will be crowned with success and our products at once take their

place as valuable elements in the economic structure of the nation.

I am not talking theory, gentlemen. I speak facts. It is possible today to determine prior to the investment of a single dollar, by an inventor, promoter, or capitalist, in an inventive enterprise, the actual worth and potential return to be expected on investment necessary to bring any artificial to the market. When this fact is realized more fully by our investors and capitalists, great strides will have been made toward our national industrial waste in time, money and materials to the irreducible minimum.

This is a principle which I have been preaching for fifteen years, and in the many years of my experience I have had but few men who came to me at the outset with a freely open mind and ask that such steps be taken regarding their invention or enterprise.

This is due chiefly to the fact that the temperament that tends toward creative genius is seldom combined with sound business judgment or intuition, while the element of suspicion is frequently highly developed. There is usually a fear that someone else will steal the idea. This characteristic has led to unending loss and disappointments.

The Question of Finance.

On the other hand, the capitalist or investor who has free money to place in such enterprise has, while realizing the speculative elements to be met, always considered these elements as more or less necessary evils to be met in the promotion of inventive enterprises. Either attracted by the possible profits to be made in the event of success, or by the glowing optimism and unsupported claims of an inventor imbued with the flame of creative faith, capital has in the past been willing to take its own chance in what is more often than not wasted effort.

The losses engendered are staggering in their proportions and yet these could all have been obviated by preliminary investigation and analysis. On the other hand, many an invention, doomed for all time to bear the hallmark of total failure, might have been a signal success had it fallen into proper hands.

One of the greatest calamities in the propagation of our industries has been and is now the extreme optimism of the inventor on the one hand, and on the other, the carelessness and haste of promoters in rushing products to the market, before the patents or the products themselves are in proper shape for profitable commercial adoption.

Many of you perhaps have had the mortifying experience of participating in the withdrawal of products from the market because of their inadequate preparation.

The question naturally arises, how are all the points to be determined which govern the success or non-success of a product until it has been tested in

the market beside competitive articles? If it is a question of preliminary examination there can be found a standard method of procedure which, when applied to any product, will serve as a guide for those interested in its development.

I might show that the necessities of industry have brought about the creation of the most elaborate technical laboratories in connection with large industries and also in connection with our leading technical schools, which are ably conducted by expert technical staffs, who by the application of scientific principles can fathom the theoretical side of all industrial problems. These laboratories can determine facts from a mass of indefinite data and apply it properly to the realm of industry. I bring these particular facts to your attention to show what organized effort can accomplish in any field of industrial endeavor.

Has not direct application of organized thinking made of advertising one of the greatest specialized sales methods the world has ever seen? You gentlemen have all contributed to the development of this science by the use of special methods of analysis of distribution through having established standard rules, with variations here and there, perhaps, depending upon the nature of the product, but in their fundamentals essentially the same.

Special Effort Needed.

These same facts apply to specialists in every line of work. The development of industry in its every angle is today susceptible to the application of specialized effort and knowledge which makes its success a foregone conclusion.

My experience has taught me that the vital need of industry is for an institutional research laboratory, where an analysis into all its possibilities from patenting, promoting, development, production, management and organization may be had. These points are all possible of scientific adaptation.

It may interest you to know that in every investigation which I have instituted in the last few years I have never cared at the outset to know the technical features of any industry but have always begun with the marketing possibilities for two very distinct reasons. If there was no market for the product, why bother with the complicated mechanism of its production? Secondly, because it is in the end the cheaper procedure and obviates the necessity and exasperations growing out of intimate contact with temperamental inventors.

I might add, too, that if the proper determination of the potential chances for the success of any product were made in advance your own difficulties and perplexities as advertising specialists would be greatly reduced. You could at least begin a campaign with reasonable assurance that a market could be created without the necessity of beating a drum and the waste of tons of perfectly good paper and printers' ink.

An organization such as I have in mind would rapidly make a place for itself in the economic structure of the nation. It would be devoid of any mechanical features but would specialize in the investigation and management of organizations. You gentlemen, through your intimate contact with industrial and manufacturing executives, can do more than any other fraternity in urging its creation.

You may be surprised when I state that despite the crying need of industry for such an organization, I can recall but few cases where the sponsors, either new concerns, or firms already operating, have voluntarily admitted they were in need of such investigation or guidance. This is probably due to the quality of human nature never to admit oneself wrong until no other recourse remains.

There is some indescribable fascination about speculation that attracts to industry the same quality which is found in the development and promotion of oil or mine properties. Mankind is perhaps actuated by the thought of great wealth quickly and easily acquired than by any other force. Hence, the willingness to assume riches. More often than not the thought usually confines itself to the imaginative and gains no more concrete value.

In the last twenty-four months, I have examined some twenty different enterprises representing an unproductive investment of from seven to eight million dollars. With this in mind, it is certain that some united effort should be made to reduce such unparalleled waste—a waste which is taking place among apparently successful enterprises representing products having basic merit, but which have shown approximately the same methods of improper conduct during their initial stages of development.

The men who conducted these enterprises were buoyed by optimism, enthusiasm and great expectations, while losing track of the main issues governing the successful development and management of their projects. A specialized knowledge of what they were doing would have set them on the right track at the beginning.

I do not wish to generalize on this point hence I will present some concrete instances of the point I am making. Of the many enterprises which I have been asked to investigate and report upon, there has been but one in which the party interested realized the importance of the principle I have preached for many years—that is investigation at the outset and not remain dependent upon luck and the grace of the Almighty for ultimate success. The others came to me only as a last resort and after hundreds of thousands of dollars, in some cases, millions, had been spent in the development of projects of which they had no basic knowledge.

I am referring particularly to the case of the Bacon Multiplying Machine, which was conceived some years ago by Mr. George F. Bacon, of Salt

Lake City, Utah. Mr. Bacon is the one man who has approached me with a perfectly open mind, and who immediately grasped the principle of my contention for a preliminary investigation to determine the marketable value of his machine before spending a penny in designing or developing it.

For twelve months I have conducted a thorough and most interesting investigation in the computing machine field, in the course of which the officials of some one hundred computing machine companies have been interviewed by my assistants. I did not before realize that there were so many computing machine manufacturing companies in the United States. You will readily realize that as a result I have collected a large volume of valuable data which compiled as it is in my organization could be used to great advantage to anyone interested in computing machine development. This information covers the situation thoroughly from patents to markets.

It is something of this sort that I meant when I referred to a co-ordinated laboratory and investigation bureau where facts and data are being constantly collected as the result of the service such an organization would have to give.

Through the investigation made for Mr. Bacon and which has shown very clearly the demand existing for such a direct multiplying machine as his, I have made it possible for our client to know in advance what his next move should be. He knows not only the demand but the particular kind of demand and the type of machine necessary to be designed to meet it and the approximate price and cost of such a product.

With these facts at his disposal we have proceeded with the designing for the market along the lines indicated as necessary by the report.

Mr. Bacon is an exception. I can present to you cases where the history has been entirely different and where men have spent large sums of money in the development of devices and processes which, only toward the end, prove to be impossible to apply to any profitable use.

Chemical Foundation

Attorney Declares Ownership of Seized Patents Sound

REPLYING to a letter from Thomas C. Dawson, of the Electric Boat Company, as to the validity of the title of the Chemical Foundation to its patents, Ramsay Houget, patent counsel to the Foundation, went into lengthy explanation of the trading with the enemy act and its relation to the seizures of chemical patents. The explanation of Mr. Houget is particularly interesting in view of the fact that the Alien Property Custodian seized over 4,000 patents. Mr. Houget says, among other things, in his letter:

"A thorough examination of each patent title was made and a report based upon such examination was rendered to the Alien Property Custodian of the enemy ownership of each of the patents investigated. The Alien Property Custodian was thus informed of the fact of enemy ownership and the provisions of section 7 (c) requiring an investigation by the Custodian are complied with. The Custodian then issued a requirement or instrument of seizure under the provisions of section 7 (c), which seizure was served upon all persons who were known to have been connected with the property seized, and was recorded in the United States Patent Office. The recording of the instrument of seizure in the Patent Office had the 'same force and effect as a duly executed conveyance, transfer or assignment to the Alien Property Custodian so filed and recorded' (section 7 (c) as amended). It will, therefore, be seen that the Alien Property Custodian was properly vested with the patents under the provisions of the act.

"As to the sale, executive orders were made on February 26, 1919, and April 5, 1919, authorizing the Alien Property Custodian to sell upon such terms as he determined, the patent, trademark and copy-right property thus seized; and in pursuance of such executive orders a sale was made to the Chemical Foundation and an assignment reciting the executive orders and other proceedings was executed by him on the 10th of April, 1919. It is therefore evident that all of the statutory requirements concerning seizure and sale were complied with and the title vested in the Chemical Foundation is absolute under the Act.

"Congress recognized that it must give to the purchasers from the Alien Property Custodian an absolute title and, therefore, section 12 of the act specifically limits any claim to any property sold to the proceeds of the sale, and thus prevents a recovery of the property itself. It states 'the sole relief and remedy of any person having any claim to any . . . property . . . conveyed . . . to the Alien Property Custodian . . . in the event of sale or other disposition of such property to the Alien Property Custodian shall be limited to and enforced against the net proceeds received therefrom . . .'

"As to the operation of the peace treaty, the peace treaty is unnecessary to validate the title of the Chemical Foundation, since, as I have pointed out above, this title is a valid title. It simply ratifies and confirms the title of the Chemical Foundation and cuts off any possible suits. Thus, Article 297 of the treaty ratifies every action taken by the Alien Property Custodian, and Annex 15 of this article makes it apply specifically to patents and similar property. This article particularly mentions the ratification of sales of enemy property under war legislation."



The Dye Works Technical Laboratory of the E. I. du Pont de Nemours & Co., Inc., Deep Water Point, N. J.

Help Consumers Solve Problems

Through Its Technical Laboratory Attached to Its Dyestuffs Department the Du Pont Company Does Everything in Its Power to Help the Users of Dyes Solve the Problems Which Confront Them.

By E. W. Pierce

*Technical Division, Dyestuffs Sales Dept., E. I. du Pont de Nemours & Company**

A FAIR share of publicity has been given to the chemistry and manufacture of dyestuffs since America began to develop its dyestuff industry at the outbreak of the war. An important phase of the business has been overlooked in giving information to the public; it is the part that technical laboratories play in developing practical dyes and in establishing a trade preference for them.

It is always necessary to determine whether a newly discovered dye is worthy of commercial existence or not. Many are not. German pre-war experience has shown us that only very few of those discovered have the necessary qualifications to justify their manufacture.

For dyes regularly made, the lots as they come from the plant must be tested to see that each meets the rigid requirements of its standard before it is offered to the consumer. These determinations can safely be made only in a technical laboratory and by a staff of experienced dye chemists, who are qualified as the court of last resort to pass judgment on such questions.

Dyestuffs are used for a great variety of purposes. Each has its own technique of application, its individual requirements of fastness and other peculiarities. It follows that a technical laboratory must be well equipped and that the staff must know not only how dyestuffs are made, but how each dye is used in specific industries.

A common service function of a technical laboratory is to help the consumer work out his coloring problems. When he requires shades to be matched on his goods in various stages of their manufacture, and is using a special type of machine for dyeing the goods, the laboratory makes trial tests on samples of his material run through a dyeing machine, which is a model of his own factory equipment.

The solution of the problem thus worked out is then submitted to the consumer.

The technical laboratory also, as a part of its service to customers, issues from time to time illustrative circulars, pattern cards and samples.

American dyestuffs manufacturers early realized that successful competition with foreign manufacturers, by producing dyes comparable in quality with those of foreign importation, required profound chemical knowledge and mechanical skill of a high order. Furthermore, they knew it was necessary for them to develop a service organization with the equipment and ability to demonstrate the high quality of American products.

The E. I. du Pont de Nemours and Company, Inc., recently opened the Dye Works Technical Laboratory, which is shown in the accompanying illustration.

This handsome building, with its two stories and basement, overlooks the Delaware river from a location just outside the Dye Works area of the Deepwater Point plant, New Jersey. It is an imposing structure of ornamental pressed brick, 200 feet long

*This article appears in the March issue of the Du Pont Magazine. Published by special permission.

and 80 feet deep, equipped with a steam heating plant, two systems for air ventilation and air purification for the large laboratories, besides the necessary gas, water, steam, compressed air and vacuum lines.

The main floor contains the executive offices, library, rest rooms, locker rooms and showers and rest rooms for employees. Here, also, are offices for the use of visiting salesmen, who review the work of the laboratory at regular intervals to become better acquainted with the new products as they are developed.

At the northern end of this floor is a spacious, well-lighted room, equipped with power-winding machines for yarns. In this room operators prepare,



The Dye-Testing Laboratory

wind and accurately weigh the yarns used for dye-testing. They also make the small bows of yarn used on sample cards. As soon as all the necessary machinery is installed complete sample cards will be manufactured in this department.

At the southern end of the corridor is the analytical laboratory with facilities for identifying unknown dyes and for determining various chemical properties of dyestuffs not included in the work of the dye-testing laboratories.

The laboratory operations and equipment on the upper floor are more interesting to the visitor. He is likely to notice first that the architects have provided abundant air space; each room, except for glass partitions, ten feet high, separating it from communicating rooms, is open to the roof, affording necessary ventilation for the chemists who are conducting their tests with heat and steam.

A large laboratory at the northern end of this floor is devoted to dye-testing. Definite amounts of dyestuffs are applied to 10-gram skeins, the operations being conducted in small porcelain, glass or enameled cups or beakers. The beakers are uniformly heated in specially designed ovens and when the dyeings are finished the skeins are dried in a large hot air oven. Each worker has his own table

space and desk and devotes his attention wholly to the testing operations.

The chemists in charge have their office in a readily accessible room adjoining the laboratory. This enables them to supervise closely all dye-testing operations.

A few steps down the corridor on the west side is the paper laboratory, equipped with miniature beaters, driers and a line of stirrers for beating small test lots of paper pulp and suction screens for converting this pulp into sheets of paper. Samples of this paper are accurately matched for color so that the paper manufacturer may have a definite idea of how he can utilize Du Pont dyestuffs in his mill. Later on, a larger beater and a 20-inch paper machine will be installed in the basement, and will be operated continuously to furnish stock for sample books and general advertising matter. The paper laboratory is also served by a weighing room such as described above.

Adjacent to this laboratory is the office of its director, which is shared by the director of the leather laboratory, and just beyond it is the leather laboratory, a miniature tannery, with its drums, paddles and vats. The operators make dye tests on leather in jars worked by a shaking machine. The "putting out" table is in this room, but the largest drums and glazing machines are installed in the basement, where the vibration will not be so heavy. Another weighing room serves this laboratory.

Across the corridor is the lake laboratory, where



The Paper Laboratory

dyestuffs are converted into pigments for paints, printing and lithographic inks, wall papers and other uses. The room contains full equipment for testing and applying dye pigments in a practical way. There are paint grinders, ink grinders, lithographic stones, offset presses, half-tone presses and all the minor adjuncts of these industries. With equipment of this sort, the technicians in charge are able to render service of a high order to any consumer who requests it.

Down the corridor to the southern end is an ex-

perimental dyehouse fitted with the dyehouse equipment used in all classes of textile mills—machines designed to dye loose stock, hosiery, cops, tops, warps, pieces, yarns, or any other forms of materials used in the textile trades. These machines are not full size, but are practical working models, capable of handling, on the average, ten pounds of material. The equipment also includes hydro-extractors and driers. In addition to the jigs and padding machines, there will soon be installed two calico printing machines with steamers, which will make possible extensive work along the lines of textile printing.

In the basement are the heavier pieces of machinery, such as leather drums, glazing machines, paper beaters and a paper machine with its calender rolls, the heating system, the machinery that supplies the building with its compressed air and vacuum service lines, and a photographic dark room,



The Leather Laboratory

equipped with photo-micrographic apparatus and a projector. Ultra-violet lamps of different types have also been installed for rapid color fading tests.

The entire personnel of the Technical Laboratory has been carefully chosen. Each member of the corps has had long practical experience, together with the necessary scientific training for his particular line of work. Considering the highly technical nature of the work and the range of problems submitted by the many consumers of Du Pont dyestuffs, it will be plain that the company has exercised wise forethought in procuring the best talent obtainable.

A competent staff of demonstrators regularly call on the trade, and also keep in close touch with the work of the laboratories. In their work in the field they frequently come upon difficult technical problems. In such cases they return to the laboratory to carry out special work on these problems.

Thus in definite, practical ways the Du Pont technical laboratory is a service institution. The company policy has always been to make quality products, and to render to its customers a full measure of service. This laboratory has been established the better to maintain this policy as it relates to the DuPont dyestuffs industry.

No finished dyestuff is offered for sale to a customer until it has been thoroughly investigated with regard to its shade, strength, solubility and general working qualities. Each product has its own standard, or type, and absolute conformity to this standard is required before any lot can be approved for sale. The Technical Laboratory is held responsible for the maintenance of these standards. It stands between the plant and the customer, furnishing a service that insures the high quality demanded alike by the manufacturer and by the consumer who uses the dyes.

It is quite evident that the work of this technical laboratory, covering as it does the control of shipments, matching customers' samples, working out coloring problems and supplying advertising matter or information for salesman and consumer, holds a place of great importance in the development of the dyestuff industry in America.

The Technology Plan

By

William H. Walker, Director Division Industrial Cooperation and Research

Massachusetts Institute of Technology

THE Technology Plan is an organized attempt to effect a closer co-operation between scientific and industrial effort: between the technical school and the individual industry throughout the country. Although a working relationship between educational institutions and industrial organizations has been discussed at great length, and on many occasions, little real practical progress has as yet been made.

The Technology Plan recognizes that for the present, at least, there must exist somewhere in this scheme of co-operation an element of individual and mutual responsibility on the part of those engaged in it. It recognizes that a purely philanthropic enterprise does not engender in the managers of industry that confidence which is an essential element in its success. Such men are not yet deeply interested in a strictly *pro bono publico* method of co-operative work. Hence, the Technology Plan is neither eleemosynary in organization nor philanthropic in its aims and methods.

The essential feature of the plan is an agreement, expressed as a contract, between individual industrial organizations and the Massachusetts Institute of Technology, under which the industry pays an annual retaining fee to the Institute, in return for which the Institute assumes certain definite obligations of such a character as it is in position to meet. These obligations are in very general terms as follows:

The great demand of the industries today is for men trained to solve the many problems with which these industries are confronted. This requires, first, a knowledge of the principles of science, and, second, a training in the application of this knowledge

to the solution of the ever recurring difficulties. While the first requirement is reasonably well met by the undergraduate courses of instruction at the Institute, only to a limited extent can the second be attained in the four years allotted to undergraduate work. The student must be encouraged to spend an additional year or more in a research laboratory or advanced study. Since the best way to learn an art is to practise it, the student is best taught to solve industrial problems by having him attempt the solution of such problems under able and experienced guidance. These problems, however, have their origin in, and owe their existence to, the industries themselves. The first point of co-operative contact, therefore, in this arrangement between industry and the Institute of Technology is that the Institute agrees to use, so far as it can, such problems as the industry will submit to it as basic material for its research work for those graduate students interested in industrial development; to give men already well grounded in science the benefit of the opportunity of working under experienced instructors upon the type of work for which they are urgently required. It is true also that much investigation in "pure science" can be conducted as profitably in fields of research which are closely akin to industry as in those realms of science far remote from general interest. This does not mean that the search for knowledge for its own sake will not continue to subtend a large arc of the activities of the Institute of Technology; but rather that such search will be activated and inspired by the realization that the hard work involved and the results obtained are recognized as an essential part of a comprehensive whole. Hence, the Institute agrees in its contract to maintain a steady stream of trained men constantly flowing into industry with the best preparation for scientific work which it is possible for it to give. At the same time, the results of the research work thus obtained will swell the store of knowledge on which the scientific progress of the community, as a whole, depends.

Men and Industry

But a corollary of this duty of preparing educated men is the duty to see that as far as possible these men take positions for which their natural ability and aptitude most nearly fit them. Further, it is desirable that, as these men develop into specialists in any particular field, their sphere of usefulness be made as wide as is practicable. Hence, the Institute undertakes to maintain a record of the qualifications, experience, and special knowledge of its alumni; to advise the contractor where such knowledge and experience as it seeks is available; to assist the contractor to obtain the technical help he requires, whether from its own alumni or from available engineers elsewhere. While this service has been rendered to some degree in the past, it has been

a minor part of, and incidental to other activities. It will now become a contractual obligation.

Coincident with the education of scientific men, there exists the necessity of educating the executives of the industries in the great economic value of science when applied to the business of their organizations. The sporadic "Yankee genius" of the past, productive though it was, must be replaced by the methods of scientific research. Genius must be provided with that most efficient tool yet produced—scientific method. While it is true that the world will ever need more knowledge, the pressing duty of industry for the present is to apply the knowledge now available. To meet this situation, the Institute provides for conferences with members of its staff, not only in its own buildings, but also at the factories of the contractor. It is hoped that the contractor will be so imbued with the possible benefits to be derived by the application of science that he will avail himself of one of the sources of technical aid readily accessible, not only at the Institute, but among consulting engineers and industrial scientists throughout the entire country. A realization of that close co-operation between the industrial interests and the educational institutions of the country, which in Germany was made so effective by the domination of both by the State, can, in America, be brought about only by a voluntary relationship between the executives of the companies and the instructing staffs of the institutions. The "Technology Plan" aims to make this relationship more easily possible; to provide a point of contact between the two interests; to open a channel of communication through which the manufacturer and the technical consultant can more easily meet. The contractor can obtain the value of his retainer only by utilizing the facilities thus made available. There will, therefore, be present in the "Technology Plan" this incentive, to at least try.

Task of the Teacher

The instructing staff of an educational institution is made up, at least theoretically, of men peculiarly adapted to render great public service by conducting research of a fundamental character—i. e., they are seekers after new knowledge, and yet, at the same time, are teachers and trainers of young men. It is important that these men be not withdrawn into purely industrial work by reason of the greater financial return offered by great corporations, or the acute pleasure which many red-blooded men feel in being professionally connected with great technical developments. Hence, the "Technology Plan" provides a method by which the staff is enabled to profit by contact with men of affairs and receive the inspiration which comes from the capitalization of effort, and, at the same time, fertilize and catalyze the instructional work of the teaching staff.

Explosion Process of Sulphate Recovery

By New Process the Alkali May Be Recovered from the Black Liquor of the So-Called Sulphate Process Without Using Any Extraneous Fuel. After Many Years of Experimentation the New Process Has Been Installed in the La Tuque Mills of the Brown Co.

By HUGH K. MOORE

Technical Superintendent, the Brown Company, Berlin, N. H., and member National Research Council*

EACH boiler is not only an evaporator, but it is also a condensor. If you will refer to the diagrams you will note that the bottom of the furnace underneath the boiler slopes continually toward the front in order to let the liquor condensed on and falling from the boiler run toward the front of the furnace.

When we first started these processes the furnaces were not built that way but were of the ordinary type of boiler setting. See diagram 5. Now sulphide, sulphate and carbonate of soda will sublime at the temperatures given and condense on the bottom of the boiler, and it is this red hot smelted alkali that I refer to when I mention liquor in a few lines above. Now as this sloping bottom is not so arranged as to let the liquor run forward you will have an accumulation of molten alkali behind the bridge wall which will run out of the clean outdoor on to your blow-off pipes. This is not a theoretical consideration, but a factor of great importance. I have seen streams of molten liquor run from the cleanout door as big as my arm. Even now once a week an accumulation of several tons has to be cleaned out.

An analysis of the above will show that the efficiency is remarkably good.

Very few coal boilers average 15% CO₂ in the gas with only 3.3% O + 6 CO. Of course the CO is high, but it must be remembered that this is primarily a smelting reducing operation and that the recovery of heat is of secondary importance, and that it is necessary to have a reducing zone in the bottom of the furnace. This is formed by the accumulation of black liquor slumping forward and as this is so rich in carbon it reduces the

Superheat in .604 lbs. steam at 580	=	164
Heat in 1.923 lbs. N ₂ + .1046 lbs. CO	=	676
Heat in .089 lbs. O ₂	=	11
Total		851

or a total of 851 B. T. U. is going off gases from boiler flues. Subtracting this from 2105 heat, these gases heat at 1950° F. We have 1254 B. T. U. for every lb. of black liquor which is blown into the furnace available for steam. From this, however, we have to subtract heat lost by radiation.

An actual boiler test shows that this is not very far from correct. The temperature of the flue gases was a little lower than those above given, viz.,

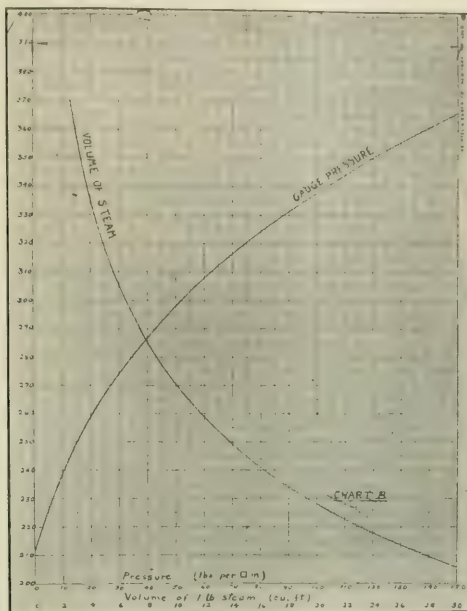


Chart B.

495° F., and of black liquor burned for one hour was 34,000 lbs. The temperature of the feed water was 135° F. and the steam evaporated per hour at 115 lbs. pressure was 28,000 lbs., so that the boiler horse power was 1,050 and the heat absorbed by the boiler per lb. black liquor burned was 900 B. T. U. This difference is probably due to radiation.

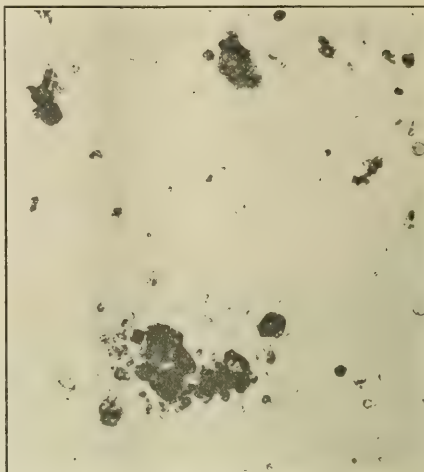
It will be seen from the above that the explosion process makes not only a good process for the recovery of alkali, which is of course the main object, but that it nets a substantial quantity of heat in available form to aid in reducing the coal bills. A few who have been privilege to see this process in operation have asked what effect gases containing so much sulphur have on the boilers. In reply I will say that we started these boilers in 1912 and have been operating them continuously since that time. The processes have been improved, but the composition of the gases has not undergone any such marked changed as to make the effect on the boiler noticeable. The boiler, however, of radiating surface in the flying particles. This surface, if kept at 1950° F., would radiate 352 B. T. U. to bodies at 211° F. The furnace walls with their 273 sq. ft.

*Concluded from January issue.

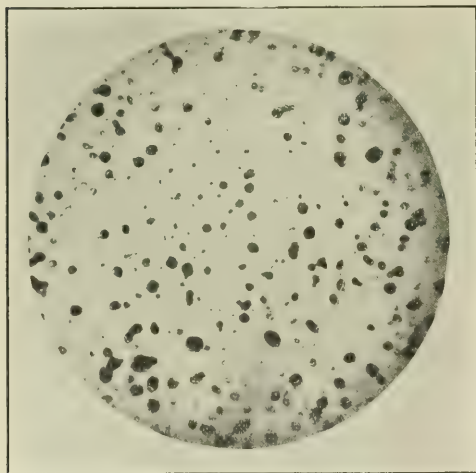
of heating surface theoretically have a power of radiating 552 B. T. U. in .32 of a second, but as they are the farthest distant from the flying particles their radiant waves are probably intercepted by flying particles so that the probability is that even though they have the heat they are very inefficient in being able to part with it to the incoming black liquor. They, however, do probably radiate some heat to some of the soda particles, which in turn radiate heat to the black liquor particles, which in turn radiate heat to the black liquor particles. What is true of the walls is probably true only to a lesser extent to the flying particles. These particles in burning are hotter than 1950° F., and radiate more heat than figured above. They are interspersed with the black liquor so that a few may radiate heat from most of their surfaces, but many are able to radiate heat from only half of their surfaces and much of this heat is intercepted in its path to the black liquor particles by other soda particles. A much greater per cent. of the radiant heat from these flying particles hits its mark, because the distances to the mark are measured in inches or fractions thereof instead of in feet, as is the case of the

the excess of oxygen, but by doing so we might lose more heat in CO than we save.

Heating the incoming liquor to a greater extent



Photograph IV



Photograph III

furnace walls, and the intervening particles must necessarily be proportionately less.

Referring again to Table IX we find that we have a considerable quantity of heat in the hot gases which can be recovered in a boiler. If we assume the temperature of the gases leaving the boiler to be 580° F. we have Na_2SO_4 running through it the excess heat for such reaction being radiated to it from above. (Note the excess nitrogen is due to thus removing the oxygen.) There may be a small change of improvement by cutting down somewhat

will not make any more B. T. U. per lb. of steam available, but it will increase the capacity of the furnace so that less will be lost by radiation. There also are liable to be operating advantages. Increased heating the black liquor increases the explosive ratio and the increased subdivision of the particles, but this will also necessitate a precipitator always in perfect condition.

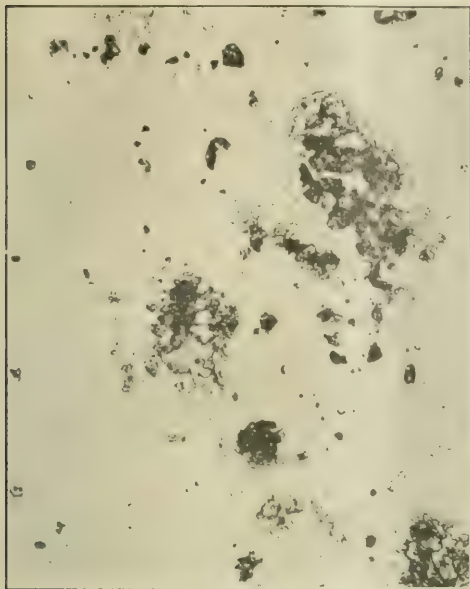
By increasing the subdivisions of the particles the chances of their receiving heat faster while in the black liquor state are increased, (1) because there are more particles on fire, and (2nd) because those particles not on fire are more intimately distributed among the burning particles and consequently owing to their proximity will receive more of the heat which would be otherwise intercepted. (3rd) the burning the excess hydrogen in the liquor and finer the particles are the greater the proportional amount of heat they receive from the surrounding atmosphere of hot gases.

A more complete reduction is obtained than the

Table IX
Outgoing Heat

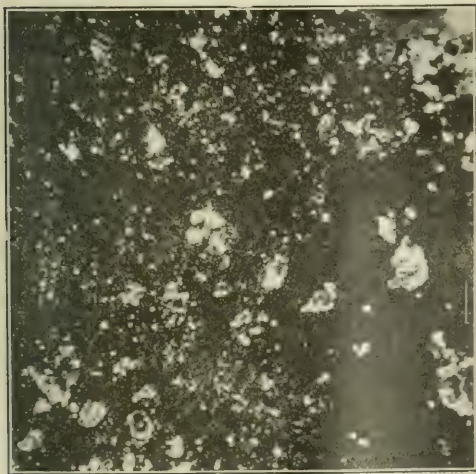
B. 1. . .	in 1 lb., liq. to 2110°f.	111.
P. 2. . .	to evaporate .447 lbs. H_2O to steam 2110°f.	614.
B. 3. . .	Required to raise .447 lbs. steam to 1950°f.	541.
B. 4. . .	to evaporate .187 lbs. H_2O at 2110°f.	163.
B. 5. . .	to raise .167 lbs. H_2O to 1950	190.
B. 6. . .	required to reduce .07 lbs. Na_2SO_4 to Na_2S	17.
B. 7. . .	required to smelt .584 lbs. soda salts	140.
B. 8. . .	required to raise .584 lbs. CO_2 to 1960°f.	32.
B. 9. . .	required to raise .0146 lbs. CO to 1950°f.	7.
B. 7. . .	required to raise .0892 lbs. C to 1950°f.	48.
B. 10. . .	required to raise 1.923 lbs. H_2 to 1950°f.	992.
		3040.

above, but this paper was started June 7 from data obtained much earlier. As far as the object of this



Photograph V

paper goes, this does not matter, as the main object in view is to show the principles involved in



Photograph VI

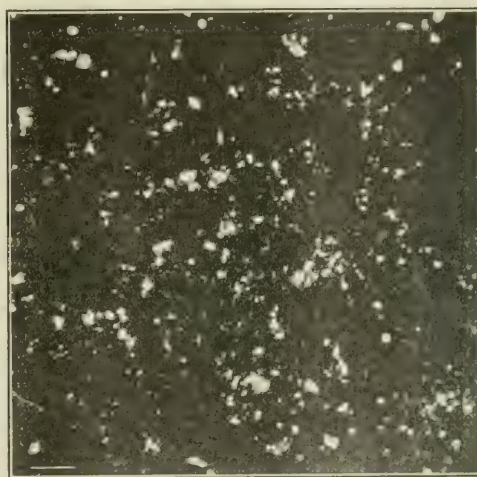
a new recovery process rather than to give specific details of one operator.

At the back of the furnace many of the particles

have broken into smaller particles, but we have enough of the large particles, such as we did not get in the front of the furnace, still intact so that they materially affect the result by adding greatly to the weight of a few particles, and thus reducing the total number of particles, but not enough to counterbalance the increased surface due to the greater percentage of smaller particles.

It will be seen from the above that burning increases the radiating surface. After complete combustion we have no internal source of heat in these particles and in order to ascertain if they could then radiate the required amount of heat we should have to consider their specific heat and find the total amount of heat in there at somewhere between 1950° F. and 2000° F. and see if they could spare the required heat,

If they received heat from no other source they



Photograph VII

would not have the required heat; they are now, however, so intimately distributed throughout all the furnace gases and they are receiving radiant energy from the walls and burning particles, so that they certainly can receive heat at the rate they are parting with it and so we need not trouble ourselves with this consideration.

From the above we may assume that, as the liquor is burning in transit, at its start it will have approximately 28 sq. ft. of heating surface as burning black liquor, while at the finish it will have no heating surface as black liquor, but approximately 320 sq. ft. in residual particles. On dividing each by 2 and adding, we should have approximately 174 sq. ft.

Canadian Pulp Exports

Quebec May Impose Further Restrictions on American Imports

THE possibility of still further restrictions on the export of pulp and pulpwood from the Province of Quebec was indicated by Sir Lomer Gouin, premier of the province, in a speech delivered at the annual banquet of the Canadian Pulp and Paper Company, held in Montreal on January 30. After reviewing what the policy of the government in the direction of restricting the export of pulpwood had done for the paper industry of the province of Quebec, Sir Lomer said that it was its intention to conserve Canadian raw materials for the use of Canadian mills.

The banquet was attended by about four hundred guests, and was presided over by George Chahoon, Jr., the newly elected president. With him and Sir Lomer Gouin, the special guest of the evening, were also at the head table J. A. Bothwell, past president, P. T. Dodge, George H. Montgomery, K. C., Howard Wilson and Henry A. Wise. The function was a spirited one, with Gitz Rice as musical entertainer.

Sir Lomer Gouin made in his address an allusion to an old parody on lines from Longfellow, which referred to lumbermen who, "living fashion fine, leave our forests departing, stripped of their spruce and pine." "I do not for a moment think that the pulp manufacturers and paper makers of the province of Quebec are actuated by any such spirit," commented the premier. "I know that you require and are actually taking vast quantities of pulpwood to feed your mills, but at the same time I know you are interested in the future of your timber holdings. I am satisfied that the Government of Quebec has given you all possible assistance in that direction. As a matter of fact, we claim that we paved the way for the development of the pulp and paper industry which now ranks amongst the most important of our country. We realized the importance and value of our forests; first we created a forestry service; next, we established in Quebec a forestry school for the recruiting of the technical personnel of this service."

Sir Lomer said they had been told many times about the immensity of our pulpwood forests, but he advised people to recollect that these are not inexhaustible. It would not be sufficient for them to reduce the volume of cut, but the time was coming for them to restock their timberlands. "If you are prepared to do your share, to restock your limits, I am sure the Quebec Government is prepared to do its share and its large share. I preach economy in lumber operations because I have great faith in the future of our forests." The premier said there were 45,000,000 acres of land under license, with a reserve of 75,000,000 acres of virgin forest. The Province of Quebec had more than half of the en-

tire pulpwood supplies of Canada and the largest unit of forest wealth in the world. "We have now cut about 1,000,000,000 feet of timber, and I am told that with proper management we may cut four or five times more that quantity without endangering the future of our supply. That is from land under license and does not include the 75,000,000 acres of land which is still free and belongs to the Crown."

Sir Lomer confessed that our knowledge was limited, and for this reason it was intended to make an inventory, for which purpose three posts would be established, at Hamilton Inlet, Ungava Bay and James Bay, from which investigations would be made and airplanes would be used if necessary. These stations would be connected by wireless.

"I do not want to pose as a prophet," added the premier, "but it seems to me that the future of this province is connected with the building up of pulp and paper plants. Our province was the first to realize the importance of keeping our raw material for the use of our mills. We do not intend to relax that policy. We may have to go further. The time may come when we will have to limit the cut of our Quebec forests for the exclusive use of Quebec men. If the situation demanded, we shall not hesitate to take this necessary measure, because we cannot forget that charity begins at home."

Sir Lomer also referred to technical education in connection with the industry and stated that the government was ready to do more if there was need for establishing a school for paper-making to meet the need. On the other hand, he asked the co-operation of those in the industry by availing themselves of those who studied in the technical schools.

Mr. George H. Montgomery, K. C., and Mr. H. A. Wise also addressed the gathering.

The plant for the production of rosin, turpentine and pine oil from pine stumps which was designed, erected and put into operation by Arthur D. Little, Inc., for the National Reduction Corporation at Calver, Ala., has been turned over to the owners as a going concern. It is of especial interest at this time in view of the demand for the reclamation for agricultural purposes of the cut-over lands of the South.

The New Jersey Zinc Company announces the contemplated construction of additional zinc oxide and lithopone plants to meet the rapidly growing demand for these products. The company plans to construct its plants at strategic geographical points. Construction work will be commenced immediately on zinc oxide and lithopone plants in Colorado and Pennsylvania.

New Jersey Zinc has already provided its ore supply for this increased production, and it aims to place itself as early as possible in a position to supply adequately the requirements of the important industries which it serves.

The experimental paper mill of the Arthur D. Little, Inc., Cambridge, Mass., is now engaged on the commercial production of acid washed filter paper. It is understood that it is able to turn out enough of this material to supply the needs of the United States. This paper was formerly imported for use in quantitative chemical analysis.

The Metric System and Our Export Trade

Bureau of Standards Expresses the Opinion that Our Exporters Are Hampered by the Retention of Present System of Measurement. Thirty-four Countries Have Adopted the Metric System.

TO get foreign business is simplified if two principles are observed—one, to furnish a superior product; two, to furnish that product in the staple or special measurements required. The Bureau of Standards, through its sixty or more scientific and technical sections, is aiding the manufacturer toward higher standards of quality and performance. The bureau has shown that due regard for standards of quality may be a potent means of steady progress not only as to the quality of material, but in methods of manufacture. Applied science is destined to control industry, and business men who first recognize this fact fully will greatly profit by it. One thing is certain—scientific Germany is out for world markets. Its pre-war success in gaining its share of foreign trade was notable. This success was due only in part to their scientific instruction in salesmanship and their system of cultivating the foreign market. A large share must be credited to the fact that their products and methods of manufacture were scientifically controlled. The dye industry, the chemical industry, the optical industry and the electrical industry are examples in point. America must compete with England, Germany and Japan on the basis of quality as well as price.

Scarcely second in importance for many lines is the question of measurement. A speedometer rated in miles would find little sale in France. Certain classes of products must not only be of correct quality, but the measures must be in units required by the customer nation whose trade we seek. This common sense is taught us by our consuls with insistence. The consuls of Great Britain have recognized it for a long time, and English export trade is profiting by the use of the metric units for foreign trade, for they realize that thirty-four nations have adopted the metric system. American business men are waking up to the crucial importance of using the metric units where required. Our provincial units are a handicap in the campaign for foreign markets, even more than in the past. In this respect, our experts in export work are far ahead of the manufacturer, for the latter cannot be as closely in touch with the buyer's demands. The guiding hand of the business man, however, is needed so that our factories may be instructed to turn out metric products whenever needed, as has been so successfully done in the manufacture of American locomotives to metric size.

We must use the language of measurement which the buyer nation knows. A foreign language of measures is forbidden to the customer. He does

not know the quantities, and, if he did, he would not buy unless the sizes were staple to the user, and in most countries such staple sizes would, of course, be metric. In many cases, unless the product is made to metric units, it will not meet his needs. An automobile designed throughout in metric units will require metric screws, since inch screws cannot be used. Similar cases might be cited by the score.

Again, the buyers in countries using the metric system require certain staple sizes rated in metric units—for example, milled lumber, shoes, small tools, etc. Some of our manufacturers recognize this and are equipped to supply metric products. It is a matter of common sense adaptation. We might as well use English where French alone is spoken as to use the English measures where metric alone are understood.

The significance of this is of the keenest interest to the American business man. Now that all the sciences throughout the world are using the metric system and that thirty-four nations have made it their legal standard, all classes in England and America are asking the vital question, "How soon will the English-speaking peoples adopt the international weights and measures?"

Public demand has already begun. The National Drug Conference, representing the big business organizations of the drug industry, at its last Washington meeting, voted full approval and urgent demand for the adoption of the metric system. The National Wholesale Grocers have favored the system; the American Institute of Electrical Engineers favor its adoption; the American Physical Society and the American Chemical Society have expressed approval. These great organizations are composed of experts who are factors in the success and progress of modern industry. A new factor has appeared which cannot be resisted, namely, the need for a universal system of weights and measures in foreign trade.

The United States, until very recent years, had a foreign trade which was insignificant as compared even with that of minor countries. Today the United States is a great producer of staples and we are a world power in business and industry. The opportunity is great but critical.

Business men, as a rule, are not well informed as to the merits of the system, although many of them already use it for export work and are prepared to fill orders with metric products. In fact, the two leading locomotive works, at Schenectady and Philadelphia, are today making metric locomotives for metric countries, using metric units in

their shops for the purpose. The blueprints are received in the American shops and the necessary metric gauges are easily made so that the manager of one of the largest works made the statement that the engines cost him not a cent more than his regular line and that mistakes were fewer, that with 24,000 workmen he was able to give them in one hour enough knowledge of the system to permit them to use it. Best of all, he satisfied his customers by his enterprise in giving them what they needed and wanted.

Congress does not forbid the use of any system in the shops, but Congress can prescribe what is the legal standard. If Congress adopts the metric system as the legal standard, it would not invalidate the use of other units as long as they might be found necessary or desirable. This is well illustrated in those countries where the metric system is now standard. The inch is permitted and even primitive measures survive in spots owing to local inertia or the habits of the aged. This is simply a case of tolerant accommodation to the natural inertia of the people.

Government Research

The Department of Agriculture Plans to Do Much Work in 1920

THE agricultural appropriation for the fiscal year beginning July 1, 1920, was reported to the House of Representatives at Washington on February 4. Its contained provision for financing a great deal of research work of interest to the chemical industries of the country.

Under the grants to the Bureau of Chemistry appeared the following grant:

For investigation and experiment in the utilization, for coloring purposes, of raw materials grown or produced in the United States, in co-operation with such persons, associations or corporations as may be found necessary, including repairs, alterations, improvements or additions to a building on the Arlington Experimental Farm, \$68,260;

For the investigation and development of methods for the manufacture of table sirup and of methods for the manufacture of sweet sirups by the utilization of new agricultural sources, \$15,000;

For investigating the grading, weighing, handling, transportation and use of naval stores, the preparation of definite type samples thereof, and for the demonstration of improved methods or processes of preparing naval stores, in co-operation with individuals and companies, including the employment of necessary persons and means in the city of Washington and elsewhere, \$10,000;

For the investigation and development of methods of manufacturing insecticides and fungicides, and for investigating chemical problems relating to the composition, action and application of insecticides and fungicides, \$20,000.

Apparently with the coming of peace the department is not going to let the question of American potash from American sources drop: under the grant to the Bureau of Soils provision is made for extensive potash research:

For exploration and investigation within the United States to determine possible sources of supply of potash, nitrates and other natural fertilizers, \$36,840;

For the investigation and demonstration within the

United States to determine the best method of obtaining potash on a commercial scale, \$192,900: Provided, That the product obtained from such experimentation may be sold at a price to be determined by the Secretary of Agriculture, and the amount obtained from the sale thereof shall be covered into the treasury as miscellaneous receipts.

Referring to the Government experimental plant at Summerland, Cal., in which potash is extracted from kelp the report says:

This amount is necessary in order to provide for new apparatus, additional supplies, acid for char extraction, and to meet the advance in the cost of labor in operating the experimental kelp potash plant at Summerland, Cal. It is estimated that \$101,000 will be realized from the sale of products at this plant for the current fiscal year. For the fiscal year 1921 it is believed that the receipts will more than cover all expenses, including the heavy overhead now entailed by a large and expensive force of chemists, engineers, and construction and repair men. Following is an estimate of receipts for 1921 on the basis of 300 days of operation:

150 units of potash per day, at \$2 per unit.....	\$90,000
1 ton of carbon per day, at \$300 per ton.....	90,000
20 pounds of iodine per day, at \$4 per pound.....	24,000
1,600 pounds of sulphate of ammonia per day, at \$4 per hundredweight	19,000

Total\$223,000

The results so far obtained indicate that the production of potash from kelp can be made a commercial success, but a number of questions need more complete investigation before the matter can be finally submitted to the public.

Tariff Report on Acids

Formic, Oxalic and Gallic Dealt with by Commission

THE Tariff Commission has issued a report discussing acids dutiable under the Tariff Act of 1918, their raw materials and a few closely allied products. These acids are formic, oxalic and gallic acids. Formic acid was controlled by the German industry before the war, because German chemists had developed the best known method of making sodium formate, the basis for making this acid. The Germans had an advantage in technical experience and commercial connections that would have made it difficult for any American manufacturer to make a successful start in this industry if competition from Germany had not ceased. During the war the complete process of making formic acid from caustic soda and coke has been developed in the United States.

Citric acid is made from "cull" lemons and is a by-product of the lemon-growing industry. Although this is a growing industry, 90 per cent. of our citric acid comes from imported citrate of lime. Boric acid is made from California borax. Tannic, gallic and pyrogallic acids are made from nutgalls, not produced in the United States in commercial quantities. Imports of tannic acid, formerly from Germany, have never been more than 6 per cent. of American production.

A decrease of almost fifty per cent. occurred in the production of Chilean nitrate in November last, according to information received in Washington. Exports showed an even greater decrease, as compared with the corresponding month in 1918.

Oxygen Apparatus and Gasoline Vapors

Government Department Tests Indicate That Rubberized Fabrics of Breathing Apparatus Are Liable to Permeation by Gasoline Vapors. Permeability Varies According to Thickness of Fabrics Used.

By A. C. FIELDNER, S. H. KATZ and S. P. KINNEY*

THE regrettable death of James S. Cunningham, Foreman Miner, attached to Bureau of Mines Rescue Car. No. 2, while wearing a half-hour type oxygen breathing apparatus in a gasoline storage tank at Trinidad, Colorado, raised the question as to the possibility of gasoline vapors permeating the rubberized fabric of the breathing bags of such apparatus.

It is known that most gases and especially certain organic vapors permeate rubber, by solution or a similar process. The rubber becomes saturated with the gas and if a concentration of gas is maintained on one side of the rubber sheet it slowly gives off gas from the other side. It of course takes some time for the gas to diffuse through the rubber and the length of time before it reaches the other side is proportional to the thickness of the rubber. The amount of gas that passes through per unit of area in unit time increases with the concentration of gas and also varies with the structure and composition of the rubber.

It has been suggested that the gasoline vapor could not have penetrated into the interior of an oxygen breathing bag because the pressure is greater on the inside, but this is not true as the process of permeation by solution in the rubber is affected only by the difference in the partial pressures of gasoline vapor on the inside and outside of the bag. The positive oxygen pressure on the inside can only prevent the entrance of gasoline vapor through measurable holes, and has no effect on permeation by diffusion through the rubber.

Test No. 1.

A sample of gasoline was obtained from the tank in which Cunningham met his death. Examination by Dr. E. W. Dean of the Petroleum Division of the Bureau of Mines gave the following results:

Specific gravity at 15° C.—.765 or 53.0°Beaume; color, yellow tinge; acidity, none; odor, good; unsaturation, 4.5 per cent. distillation in Engler Flask, barometer 751 mm.

First drop	60 degrees Centigrade
10 per cent.	96 " "
20 " "	111 " "
30 " "	123 " "
40 " "	135 " "
50 " "	147 " "
60 " "	160 " "
70 " "	172 " "
80 " "	185 " "

90 per cent.	207 degrees Centigrade
Dry Point	242 " "
97 per cent. distilled.	
1.2 per cent. residue; 1.8 per cent. loss.	

This shows the gasoline to be heavy and typical of the gasoline sold throughout Colorado for motor fuel. A Salvus half hour oxygen apparatus was arranged with the breathing bag only in a gas tight box in which the space was kept saturated with the vapor of this gasoline. The main part of the apparatus was outside the box. Oxygen from the apparatus was breathed by a man in the usual manner. Gas samples were taken from the box at intervals to determine the concentration of gasoline vapor, also samples of the oxygen breathed were taken from a side tube in the mouthpiece. The room temperature was 75° F. The concentration of gasoline vapor in the box at the beginning of the test was 4.3%. The man breathing from the apparatus thought he detected gasoline in his oxygen in two minutes after starting the test. Analysis of the inspired oxygen at this time showed 0.03% gasoline vapor. The same man remained on the apparatus for 18½ minutes without suffering any ill effects. His place was then taken by another man who wore the apparatus until the oxygen was exhausted without noticing more than a trace of gasoline at any time. At the end of the test the inspired oxygen contained 0.07% gasoline vapor. The total time of test was 38 minutes.

Test No. 2.

It was thought probable that the temperature in the gasoline tank at Trinidad was higher than 75° F. and therefore caused greater penetration. A second test was therefore made several days later with another portion of the same gasoline with the room temperature at 95° to 104° F. The wearer noticed gasoline in 12½ minutes after starting the test; at this time his inspired oxygen contained 0.07% gasoline vapor. He continued on the apparatus after detecting gasoline for a period of 14½ minutes when he became dizzy and stopped. At this time his inspired oxygen contained 0.28% gasoline vapor. Another man then put on the apparatus and continued breathing for 14 minutes when the oxygen became exhausted.

Test No. 3.

In order to obtain information on the rate of permeation of breathing bags in higher concentrations of gasoline vapor, another apparatus of the same make and type was tested in the same manner

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as in tests 1 and 2 except that the box was saturated with the vapor of a very volatile casing-head gasoline. Analysis of gas from the test box showed 36 per cent. gasoline vapor at the beginning of the test and 32 per cent. at the end, which was 22 minutes later. Gasoline vapor was suddenly detected by the wearer of the apparatus in nine minutes after beginning the test. A sample of oxygen from the mouthpiece then showed 1.15 per cent. gasoline vapor. After breathing for three minutes longer the man could endure it no longer; he found it necessary to hold a table in order to stand and objects were swimming before his eyes. Analysis now showed 2.22 per cent. gasoline vapor in the oxygen. Three minutes later 2.60 per cent. gasoline vapor was found in the oxygen. Another person attempted to breathe this mixture but could take only 10 or 12 breaths before he became quite dizzy.

Experiment with Bag Immersed in Liquid Gasoline—Test No. 4.

A fourth experiment was performed with another similar apparatus in which the breathing bag was partly submerged in ordinary motor gasoline of 63 degrees Baume gravity. Half the bag was beneath the surface of the gasoline and most of the bag was wet with the liquid. Four minutes after immersing the bag, gasoline was noticed by the man breathing; analysis now showed 0.05 per cent. gasoline vapor in the oxygen. Breathing was continued for nine minutes longer when the subject thought the gas was becoming rather strong and felt he would soon be affected by it. The test was then stopped. The oxygen showed 1.09 per cent. gasoline vapor. However, the subject, a strong, robust man, did not feel any ill effects from the amount he inhaled during the experiment.

The total time of immersion of the bag in gasoline was 13 minutes. Examination of the interior of the bag immediately after the test showed that the gasoline had penetrated and acted on the rubberized coating rendering it soft and sticky like rubber cement.

Conclusions.

These experiments show that the thin rubberized coating used on the Salvus half hour oxygen breathing apparatus is rather easily penetrated by both liquid gasoline and high concentrations of gasoline vapor, such as may be expected in a tank containing some volatile casing-head gasoline. While ordinary motor gasoline does not seem to produce high enough concentrations of gas to penetrate in dangerous quantities through a bag free from defects in a period of 10 to 15 minutes, yet the need of a much more impermeable bag is certainly demonstrated.

The bags now furnished with some half hour types of breathing apparatus, such as the ones tested, consist of cloth fabric coated with a thin rubber

cement like material that is decomposed by gasoline and is penetrated by the vapors in a much greater degree than the heavier rubber fabrics used on the two-hour types of apparatus. These heavier bags must also be under suspicion for such purposes until thoroughly investigated.

The Bureau of Mines is taking up this subject with a view to recommending more impermeable materials not attacked by gasoline or similar liquids. In the meantime, users of oxygen breathing apparatus in high concentrations of gasoline, benzol and other organic vapors should observe all precautions and always attach a life line to the wearer so that he can be immediately drawn out of the dangerous atmosphere should he show distress.

British Favor Cyanamid

Nitrogen Committee Recommends Use of Synthetic Nitrogen Processes

THE final report of the British Nitrogen Products Committee issued in January recommended the adoption of measures for the synthetic production of nitrogen. This step was necessary, the report stated, to enable the united country to dispense with Chilean nitrate in wartime.

Combined nitrogen could be obtained, the report claimed, by synthetic processes at a cost at the factory, which is less than half the market price of combined nitrogen from other sources.

The committee urges that the calcium cyanide process should be established in Great Britain without delay, and that the scale of manufacture should be sufficient to give an output of about 60,000 tons of cyanamide per annum. The necessary electrical energy should be obtained either from water-power in Scotland or from a large steam-power station. They further recommend the establishment of the synthetic ammonia and the ammonia oxidation processes, and submit proposals for conserving and increasing the output of combined nitrogen from existing by-product ammonia industries, for securing the better utilization of the national resources in coal, and for reducing the consumption of raw coal as a fuel.

Stress is laid on the need for trial operations and research and the national interest, and it is suggested that a coordinated policy should be framed for safeguarding the future nitrogen requirements of the Empire. The committee points out that, as far as the United Kingdom is concerned, nitrogen fixation and allied processes will constitute a new "key" industry. They are, therefore, of opinion that its initiation and development will require the active support of the government.

The experimental paper mill of Arthur D. Little, Inc., Cambridge, Mass., has been busy for some months on demonstrations of the paper making quality of linters and cotton hull fibre which, during the war, were the chief source of cellulose for the nitrocellulose used in smokeless powder.

Dynamite Extinguishes Gas Well Fire

Ingenious Placing of Explosives Saved Gas Well After Half a Million Had Been Wasted in Trying Other Methods of Salvage

By A. H. CLOUGH

Technical Expert, Giant Powder Co., Con., San Francisco, Cal.

WHAT is conceded to be the largest gas blaze ever encountered in the oil producing industry occurred at one of the Standard Oil Company's wells near Taft, California, about midnight July 26, 1919. With a flow of 180,000,000 cubic feet of gas every 24 hours, shooting upward under enormous pressure, the well blazed for ten consecutive days and nights. All known methods of extinguishing it were tried and proved of no avail, until the plan of putting it out with explosives was submitted and tried. To Ford Alexander belongs the credit of this idea; who risked his life in bringing his plan to a successful issue.

The Standard Oil Company was drilling with a rotary drill in well No. 7, in the Elk Hills, near Taft, in the Midway Oil Fields, California. The well was at a depth of 2,135 feet in ten inch casing, when a supposed water sand was encountered. To test this sand for water, the mud in the well was bailed down to relieve pressure, and to allow any water present to accumulate in the well. During the course of bailing, at 11 P. M., July 26, the well blew out under tremendous pressure and the greatest flow of gas in the history of oil production began.

The drilling crew attempted to get the well under control by closing the 12½ inch gate valve with which the casing was equipped but the shale and sand carried by the stream of gas cut out the seat of the valve while the gate was being closed, and the well continued to blow. Two hours after the flow began, the friction caused by shale and sand traveling at a great velocity had produced a red hot heat on the casing, and the gas, igniting, burst into a column of fire, gushing three hundred feet skyward. Its maximum width of about fifty feet was reached after the flame traveled about one hundred feet upward. The gas emerged from the casing with such force that for a distance of twelve feet about the casing there was no flame.

The derrick, one hundred feet in height, was immediately consumed, and all that remained was a twisted mass of iron and steel and machinery.

Metal at the casing melted, while within a radius of fifty feet it was reduced to a white heat. Everything within hundreds of feet was burned and baked.

A thermometer, registering 300 degrees F., broke at a distance of 250 feet from the fire.

It is reported that the fire could be seen from a distance of eighty miles, while the roar from the escaping gas could be heard at a distance of ten miles.

Men could not hear each other shouting within a radius of one thousand feet of the well, and deafness resulted among the fire fighters. All plans were carried out by signals.

The first attempt to extinguish the fire was made July 28, by the assembling of ten boilers. From both the blowoffs and the steam connections of these boilers three inch lines were laid to within fifty feet of the well where each branched into two two-inch lines and ran to the base of the flame. With the base of the flame twelve feet above the ground level, the work of laying these pipe lines, nevertheless, became a matter of human endurance against heat. The men worked behind large portable metal screens, with a stream of water constantly playing upon them from a three-inch fire hose. Water lines were also laid, and with the boilers and pumps throwing steam and water into the flame to their full capacity there was no noticeable effect upon the fire.

Shortly after all the casing above ground blew off, and the well began to crater, allowing the flame to draw down to the ground level.

The second attempt was made with the full capacity of sixteen boilers and four pumps throwing steam and water through three and four inch lines, but this effort showed no more results than the first.

The third attempt was made with twenty boilers throwing steam and water, four rotary pumps throwing water, two 125 barrel tanks with four inch steam jetted lines, and two pumps throwing fire foam.

With the preparation for the fourth attempt completed, there were twenty-one three inch lines and nine four inch lines into the fire crater. Twenty boilers and eleven rotary pumps ready to throw steam, water, mud and carbon tetrachloride. This attempt along with the fifth attempt to extinguish the fire was a failure.

Officials of the company brought artillery officers from the Western Department, U. S. Army, who considered bombarding the well with field howitzers, but who reported that portable artillery was too small in calibre to accomplish the task.

Thus through the fatiguing efforts of nine days and nights, in which time the company expended nearly a half million dollars they arrived at the point where all effort seemed in vain, and had reached the end of their resources.

The company now considered the idea advanced by Ford Alexander of conquering the fire by ex-

plosives. Mr. Alexander does practically all of the oil well blasting in the California fields. His experience and knowledge of explosives led him to the idea advanced, which was, essentially, to suspend a package of blasting gelatin upon cables in such a manner that the package could be safely brought to the edge of the fire at a distance of about forty feet above the ground.

Two derricks approximately forty feet high were built on either side of the burning well and so far away that the heat would not destroy them. A 9-16 inch steel cable was attached to the top of one of them, then laid around the well outside of the terrific heat zone, to the other derrick where it was run through a pulley at the top and the end attached to the drum of a small winding engine underneath. The explosives, bound in one package and covered with heavy sheetings of asbestos, were securely attached to this cable at the same distance away from the first derrick as the burning well was. The explosives, before being made up into this package had been primed electrically. When this was done, the engine under the second derrick began drawing the cable taut which pulled the explosives toward the well and at the same time hoisted them. When they had reached the proper spot, they were exploded electrically. It is unnecessary to state that this had to be done very quickly so as to bring the explosive charge to the necessary point before they were ignited or exploded by the heat from the burning well.

With a stream of water from a three inch hose playing upon him, and upon the protecting screen behind which he was working and upon the ground over which he was advancing, Mr. Alexander worked forward with the explosive package for the purpose of being sure that the package was in the position he wanted it at the moment of explosion.

As the package drew near the column of gushing fire the suction of rushing air drew it to the flame, and as it reach the outer edge of the fire Mr. Alexander exploded the package. At the moment he exploded it he was within two hundred feet of the explosion but states that he neither heard nor felt anything.

Eye witnesses at a greater distance state that when the package exploded, the gas well was divided into three sections. The section at the point of explosion was moved bodily away from the column of gas in a horizontal direction, the upper section was blown upward and beyond danger of re-ignition of the gas column, while the lower section was snuffed out very much as a candle is snuffed out, the flow of gas being temporarily checked.

To get an idea of the enormous amount of gas flowing from this well one has but to note that the entire city of San Francisco consumes but 22,000,000 cubic feet of gas each day, and that this well alone would supply more than enough gas for eight cities the same size.

The Standard Oil Company expended nearly a half a million dollars in vain attempts to extinguish the fire, and had arrived at the end of its resources in oil well fighting. Army artillery officers were called upon but could advance no plan to snuff out this colossal blaze.

Then explosives come to the aid of men displacing old ideas and methods with new ones that are more economical. In the future, gas well fires, oil well fires, and oil reservoir fires, will be extinguished with explosives at a small comparative cost to what has heretofore been expended.

Utilizing Pine Waste

Virginia Polytechnic Institute to Investigate
Utilization of Stumps

THE Virginia Polytechnic Institute at Blacksburg, Va., under the direction of its department of chemistry, has begun an investigation of methods of utilizing pine waste, according to *The Manufacturers' Record*.

Dr. J. B. McBride, of the department of chemistry and engineering of the Institute, says that the problem presents most attractive possibilities, and that a start will be made on a small scale, but that if it develops satisfactorily the operations can be enlarged. Graduate students and advanced students are being assigned to the work, under the direction of the faculty, it is understood. Both dry distillation and steam distillation of the so-called "fat wood" from the yellow pine waste will be investigated and experimented with. Important results are expected.

Removal and utilization of the pine stumps that are thickly scattered over the coastal plain and other cutover lands in the South is a problem that those engaged in the development of the lands have had some trouble with. The stumps occupy a good deal of space. They interfere to some extent with the use of agricultural machinery. They are big and heavy, have a tap root running deep into the ground, and the cost of removing them is considerable. The answer to these difficulties is to utilize the stumps by obtaining valuable by-products from them.

This is being done in a limited way. One Georgia distillation plant obtains 26 different products from yellow pine stumps, including turpentine, charcoal, rosin, wood for pine oil, etc. There are plants engaged in distilling yellow pine products at Gulfport, Miss., and Jacksonville, Fla. Near Hattiesburg, Miss., there is a small distillation plant operated by the Farris Brothers, Syrians, who are taking on contracts for clearing land and obtaining by-products from the stumps. It is reported that a new process is being worked out by another concern at Hattiesburg that will be better than any heretofore tried. The Reolds Farms Co., of Olds-

mar, Fla., in which the Olds automobile people are interested, is watching developments at Hattiesburg and elsewhere with a view to perfecting the removal and utilization of stumps on its lands.

Alex. K. Sessoms, of Cogdell, Ga., has been shipping five carloads of stumps per day taken off his land to a distillation plant. He gets enough money out of them to pay for their removal and transportation, so that his land clearing costs him nothing. Mr. Sessoms is raising livestock, sugar cane and sweet potatoes on a profitable basis on the cut-over land he is clearing without expense at the rate of 1,000 acres a year.

There are other instances of successful utilization of yellow pine stumps at a profit, but scientists and land developers realize that there is considerable yet to learn about the pine stump and how it can be made useful by extracting its substance in the most efficient, thorough and cheap manner. The elements in pine stumps are mixed, and it is difficult to segregate and take them out and find uses for some of them. It is hoped that the experiments at the Virginia Polytechnic Institute and the investigations that are said to have been made at the North Carolina University in yellow pine will hasten the development of more perfect and efficient processes. One of the principal difficulties experienced in clearing land in the South will then be met.

The executive vice-president of the Southern Settlement and Development Organization, Clement S. Ucker, of Baltimore, has expressed the opinion that the time will come when the Southern landowner generally will be paid for the privilege of taking stumps out of his land. He has been instrumental in assisting the Virginia Polytechnic Institute in inaugurating its studies of pine wastes, and the development organizations of the South will co-operate with the Institute in its work by supplying material and otherwise. Specimens will also be furnished for the industrial exhibits at the Virginia Polytechnic Institute.

It is well known that the supply of naval stores (turpentine, rosin and tar) is declining with the cutting out of the yellow pine timber of the South, it having been stated that Southern turpentine forests, formerly yielding 600,000 barrels a year, can't be expected to yield over 400,000 barrels a year. To such an extent is the decline in the source of supply recognized that Southern naval stores operators, according to the United States Department of Agriculture, are planning to seek new sources in the West, and the department has been studying the Western yellow pine with that end in view. Yet there are so many millions of acres of long-leaf pine stumps that E. A. McKoy, of New Orleans, who has a process of reducing them to distilled products, has estimated that there is enough raw material available in the stumps to supply the world

with turpentine for 300 years at the present rate of consumption. Hence the wide interest manifested in the new work of the Virginia Polytechnic Institute.

Medicated Alcohol

Official Formulas Used Without Harm Since 1912

FORMULAS prescribed by the Bureau of Internal Revenue for medicating alcohol intended for external use have been employed since 1912 without report of serious consequences to any person so using it, it is stated by the Bureau of Internal Revenue.

Under a Treasury decision, issued January 26, 1912, incorporated and chartered institutions were permitted to withdraw alcohol tax free and use it for antiseptic purposes, provided it was so medicated as to conform with any one of sixteen formulae prescribed by the Bureau of Internal Revenue. The number has since been reduced to seven, which are contained in Regulation 60, recently issued by the Bureau of Internal Revenue, governing the use of alcohol.

Several of the formulas were recommended by hospitals, which since 1912 have used them for external use in the treatment of patients.

To insure the use of medicated alcohol for external use only, the Bureau of Internal Revenue has ruled that there shall be placed on each container thereof the word "poison."

Its use for beverage purposes, of course, is dangerous, says the statement, and the Bureau has taken every possible precaution to so inform the public.

Tartaric Acid Process

Various Acids Can Now Be Derived from Coal Tar

TARTARIC ACID from coal tar by a new method has been developed on a satisfactory scale, it was stated recently at a meeting of scientists by the inventors and patentees of the process. Not only can tartaric acid be obtained, but a number of other important substances necessary to economic development and aidful toward the lowering of the cost of living and lessening the force of prohibition enforcement.

The details were explained in a joint paper read before the New York Section of the American Chemical Society at 50 East Forty-first street, and written by the inventors and patentees of the process, John M. Weiss and C. R. Downs, respectively, the manager and the chief chemist of a well-known firm of chemical manufacturers.

The basis of the process is a method of building up various substances from maleic acid obtained from benzol, one of the derivatives of dark and

viscid coal tar. Maleic acid has been separated from the juices of certain plants and fruits, but at so high a cost that it could not be put on the market and was considered merely as a laboratory curiosity. By the Weiss-Down process benzol is mixed with air and the vapor is passed over a catalyzer, a material which alters the speed of chemical reactions without being in itself affected. On account of their mysterious power to join other substances in chemical wedlock, catalyzers are known as "chemical parsons."

With maleic acid as a base, it is possible to prepare other valuable acids.

Of these, the most welcome to the housekeeper and the trade is tartaric, which hitherto has been made from the cream of tartar, a solid found in the bottom of wine casks and employed principally in the making of baking power. The United States, before the prohibition wave engulfed the vineyards where wine grapes are raised, produced 10,000,000 pounds of cream of tartar a year and about 1,000,000 pounds of tartaric acid. As the cream of tartar cannot be obtained except through the fermentation of the wine, the grape juice industry is unable to supply the household want hitherto filled from the vats of the vintner. There was a large importation from Europe before the war, but it was checked by the military situation.

By the new process citric acid can also be derived from the maleic acid base. Citric acid causes the sour taste of lemons and other citrus fruits and is used in lemonade and orange drink compounds. It is much employed also in the arts.

Lactic acid can also be manufactured inexpensively by the new method. It was originally derived by fermenting milk, as its name implies, although there are now several other processes for preparing it synthetically. Recently farmers have been giving lactic acid as a tonic and appetizer to pigs, for although the porcine breed is supposed always to be hungry, it is found that its craving for food and powers of assimilation, and therefore its weight, could be greatly increased by such a prescription. This acid is consumed in large quantities in the dyeing of wool and is of much worth in various industries.

Succinic acid, which is useful in making many laboratory tests, can also be derived at a low figure by the newly devised method. As it is obtained by the distillation of amber ordinarily, this substance is costly.

Maleic acid synthesized from benzol, the inventors state, can also be employed as the basis of new dyes, medicinals and perfumes. They believe, in fact, that it will open up an entirely new field of synthetic organic chemistry. Arrangements are being made to manufacture products from this new source on a large scale, as the process would render the United States independent of foreign supplies

of several important raw materials. Three American patents have been issued to the authors.

Richard Levering Dead

Death Removes Leading Member of Well Known Oil Firm

MR. RICHARD LEVERING, head of Richard Levering & Co., petroleum engineers, during the war chief engineer of the mechanical section of the American University Experiment Station of the War Department, died suddenly on January 29, in New York City.

Although still a young man, the late Mr. Levering was a leader in the development of the American petroleum industry, and during the course of the war, as an executive officer of the Chemical Warfare Service, Research Division, rendered good service to his country.

Mr. Levering was born in Lafayette, Ind., in 1881. He was graduated from Yale University, where he was prominent in rowing and boxing in 1902. Borrowing \$5,000 he started his first oil company, the Indian Refining Company, of which he was president from 1902 to 1912. This was a great success.

Later Mr. Levering acted as the executive representative in the United States of the Royal Dutch Shell Petroleum Company, organizing its subsidiary companies and purchasing properties for it in the United States and Mexico.

Just before the entrance of America into the war Mr. Levering organized and was the managing director of the Island Oil and Transport Corporation, which developed some of the largest oil wells ever drilled in Mexico, and attained second place in point of shipments from Mexico. In spite of these activities in his own business, Mr. Levering gave most of his time in 1916, 1917 and 1918 to the service of the Government.

At the time the United States declared war on Germany he was a special agent in the Department of Justice, chief of the American Protective League, Secret Service Division, New York, and special representative of the Department of Justice in Latin-American countries. During the war Mr. Levering was chief engineer of the mechanical section of the American University Experiment Station of the War Department, a major in the army and executive officer of the Research Division of the Chemical Warfare Service.

He was detailed also for a time to the navy, Aviation Section, Bureau of Ordnance. He also had acted as consulting engineer for the navy in the preparation of reports to the Senate on questions of fuel oil supply and oil specifications. He organized Richmond Levering & Co., Inc., in 1914.

Major Levering was commander of the Chemical Warfare Post of the American Legion. He was a member of the University, New York Yacht, New York Athletic and Sleepy Hollow clubs.

Dept. of Public Works

Movement Under Way to Eliminate Department of the Interior

HEADED by Mr. Adolph Lewisohn, a New York financier, and Mr. J. Parke Channing, president of the Miami Copper Company, a nationwide movement is under way to substitute for the Department of the Interior a National Department of Public Works. A committee is now being formed in New York City to handle the campaign which will shortly be organized to gain the co-operation of business men and engineers in all parts of the United States.

Mr. Channing, the vice-chairman of the New York committee, is chairman of the Engineering Council, which embraces the members of the American Society of Engineers, the American Institute of Mining and Metallurgical Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, United Engineering Societies, and the American Society for Testing Materials. Professor James T. Grady, of Columbia University, New York City, has consented to act as secretary of the committee, and Mr. Francis Blossom, of the firm of Sanderson and Porter, is working with Mr. Lewisohn and Mr. Channing in the formation of the New York committee.

In a statement issued by Mr. Lewisohn and Mr. Channing in behalf of the committee, the scope and purpose of the work they are organizing is described as follows:

Mr. Channing stated that 114 national, State and local societies having an aggregate membership of over 100,000 engineers, architects, constructors, manufacturers, chemists, geologists, economists and business men, were behind the movement. The National Public Works Department Association, a league composed of these societies, had been founded, he said, to prosecute the campaigns in every section of the country.

The first public demonstration by the New York committee would be a mass meeting of engineering societies in the auditorium of the Engineering Societies Building, 29 West Thirty-ninth street.

"The purpose of the movement is to organize under one department the many and varied public works functions of the Federal Government. These functions are now scattered through nine separate departments and thirty-nine bureaus and services. It is this independent operation and competitive relation of like functions which in a large degree renders the government so wasteful and inefficient in its business conduct. A private business operated in that way would soon become bankrupt.

"The proposal to establish a Department of Public Works is but the first step in the rationalization of government business conduct. The establishment of such a department would create an indus-

trial organization out of many functions and thereby make it possible for the Government to conduct its public works business according to the same principles that have made American industries so successful."

Recommends Dye Embargo

Senate Committee Disapproves of Longworth Plan for Imports

THE Senate Finance Committee on February 15 presented its report on the bills now pending in Congress dealing with the importation of dyes and dyestuffs. The committee expressed its disapproval of the Longworth licensing plan and expressed its approval of an embargo similar to that in operation against Germany during the war, as the best method of protecting the American dye industry.

The recommendations of the committee were as follows:

"Your committee recommends that the sections of the House bill providing for the issuance of licenses to persons desiring to import foreign dyes for domestic consumption be stricken out, because we are opposed to a license system in the United States and do not desire to see the Government take the initial step in entering upon such a system. The reasons for this are as numerous as they are obvious, and we do not deem it necessary to enter upon any extended argument as to the merit of our contention.

"Your committee further recommends that instead of the license system provided for in the House bill there shall be established an embargo on the admission of dyes to this country, to be administered by the Tariff Commission in accordance with such rules and regulations as the commission may adopt within the limitations imposed by this act.

"Section 504 provides that for three years after the approval of this act no dye or intermediate shall be admitted to entry into the United States or any of its possessions unless the Tariff Commission shall determine that such article or a satisfactory substitute therefor is not obtainable in the United States or any of its possessions on reasonable terms as to quality, price and delivery; and furthermore that such article is required for use by an actual consumer.

"Section 505 defines the term 'reasonable quality'; Section 506 defines the expression 'reasonable terms as to price,' and Section 507 defines 'reasonable terms as to delivery' as used in Section 504.

"Section 508 provides that the Tariff Commission may make all rules and regulations necessary and proper for the accomplishment of the purposes of this Act, provided that no article enumerated in either Group 2 or Group 3 of Section 500 of the

Act shall be admitted to entry into the United States or any of its possessions in any case where the Tariff Commission shall determine that the actual consumer for whose use such article is intended has received or may obtain a six-months' supply of the article he seeks to import.

"Section 508 further provides that no article enumerated in either of the above groups which may be useful both as a substitute for a domestic article and at the same time suitable for use for some other purpose for which the domestic article is not adapted shall be admitted to entry unless the Tariff Commission shall determine that such article is imported for such other purpose.

"Section 509 provides that the Tariff Commission shall have exclusive jurisdiction of the distribution among the consumers in the United States of any articles which may be available under the treaty of peace with Germany.

"Section 510 provides that notwithstanding the prior termination of the present war, the provision of the trading with the enemy act which prohibit or control the importation into the United States of dyes or intermediates are continued for a period of ninety days, beginning with the date of taking effect of this act.

"Sections 511 and 512 confer upon the Tariff Commission other powers deemed essential for the successful execution of this act, while sections 513 and 514 fix penalties for the violation of any of its provisions.

"Section 518 declares it to be the intent of Congress in enacting this act to build up, develop and protect the dyestuffs manufacturing industry in the United States, and also thereby practically lays the injunction upon the Tariff Commission to so construe and effectuate such intent.

"Without going into the details of the operation of this system your committee believe that will at once protect the manufacture of all those dyes and intermediates that are now being produced in the United States, will enable those who desire to manufacture those dyes and intermediates that are not now being produced in the United States to embark with confidence upon their production, will enable all the dye users in the country to obtain on reasonable terms as to quality, price and delivery all the dyes needed for their purposes, whether produced here or abroad, and will within the time limit fixed by the bill establish a complete dye industry in this country that will fully meet the demands of the American consumer and permanently establish this great industry on an enduring basis.

"Your committee believe that inasmuch as this bill provides for a system of embargoes that will protect the manufacturers of dyes in such imports alone—those provided by the existing law—therefore recommend that the rates provided in the House bill shall be amended by the insertion of

those provided by the law approved on September 8, 1916.

"Your committee believe that some import duties are necessary in order to protect those domestic manufacturers who desire to enter upon the production of those dyes and intermediates that are now being made in the United States, and therefore by a majority vote recommend that the existing rates be retained. We therefore recommend the passage of the bill with these amendments."

Chemistry's New Mission

Dr. Noyes Tells Chemists of Their Enlarged Opportunities

CHEMISTRY'S enlarged mission to mankind was proclaimed by Dr. William Albert Noyes, recently installed president of the American Chemical Society, in an address delivered before the Rochester Section of that organization on the evening of January 19. In view of the present trend, the address of Dr. Noyes at Rochester on "The Foundations of Chemistry" is regarded as of wide interest to industry, education and science.

The selection of Dr. Noyes as the head of the American Chemical Society for 1920, with its membership of more than 13,000, is therefore of unusual interest at this time. He is one of the leading physical chemists in the United States and his wide researches with regard to the relations of molecules and atoms parallel in America those of the great leaders of British chemistry, Sir Ernest Rutherford and Sir Oliver Lodge.

He has been identified for many years with the great effort being made both by university and technical chemists to establish on a firm basis America's position in chemical research. The results of the efforts of such research men in the last quarter of a century was shown by the supreme test of the European war, in which the American chemists were called upon to face the myriad problems of chemical warfare, chemical production and chemical creation.

In token of his position among the research leaders of the United States, Dr. Noyes was one of the earliest recipients of the Nichols Medal (1908), awarded for his work on the atomic weight of chlorine, and recently he received the Willard Gibbs Medal from the Chicago Section of the Society for his pioneer work in the field of the electro-chemical theory of valence.

This well known chemist was recently elected chairman of the chemistry section of the National Academy of Sciences, and he is also a member of the American Philosophical Society and of the American Academy of Arts and Sciences. He is widely known as a journalist of science, and from 1902 to 1917 was the editor of the Journal of the American Chemical Society.

Richard C. MacLaurin

Late Head of M. I. T. Man of Varied Attainments

RICHARD COCKBURN MACLAURIN, president of Massachusetts Institute of Technology, and the man chiefly responsible for its success and rapid growth during the last eleven years, died at his home in Boston on January 14. His death was caused by pneumonia contracted in New York City when he personally undertook the completing of arrangements for the jubilee alumni dinner. Dr. MacLaurin was only forty-nine years old.

It was at the jubilee alumni dinner that the identity of the mysterious "Mr. Smith," to whom the institute was indebted for gifts of money totalling \$10,700,000, was made known. George Eastman, "the Kodak King," of Rochester, N. Y., was announced as the donor of the money, and it was stated too that his gifts since March, 1912, had amounted to an even \$11,000,000.

The successful termination of the drive for funds was the climax to Dr. MacLaurin's efforts to place the institute on a solid financial basis. During the drive he introduced an innovation for other technical schools to adopt by offering the services of the institute as technical adviser to commercial establishments at regular rates.

Dr. MacLaurin was born in Edinburgh. His early boyhood was spent in New Zealand. He received his preliminary education in English schools. Later he entered Cambridge and remained to take the degrees of master and bachelor of arts.

After graduation from Cambridge and a ten-months' visit to the United States and Canada, during which he inspected many educational institutions, Dr. MacLaurin returned to the English university to study law.

He became a professor of mathematics in the University of New Zealand in 1898. Later he became a trustee of that school and took a leading part in the organization of technical education in the colony.

Coming to the United States again in 1907, he took the chair of mathematical physics at Columbia University. He ultimately became head of the department of physics there, but left to assume his duties as president of Massachusetts Institute of Technology. Serious financial problems confronted the institute at that time; it was restricted in its work and there was need of larger quarters. During two years Dr. MacLaurin familiarized himself with the needs of the institute.

The value of his policy was reflected quickly in the gift of half a million dollars from T. Coleman du Pont. The money was utilized for the purchase of a new site at Cambridge. He received the enthusiastic backing of the alumni in his ideas of a "greater 'Tech'" and soon there was a complete new home.

The Future for Petroleum

Head of Standard Looks for Larger Demand During 1920

WALTER C. TEAGLE, president of the Standard Oil Company of New Jersey, in a survey of the future of the oil industry, which he prepared apropos of the anniversary of the chartering of the original Standard Oil Company fifty years ago, predicts that the great problem to be solved is the meeting of increased demand in the future. He estimates that in 1925 the total needs of the industry in this country will be some 650,000,000 barrels, as compared with the 436,000,000 barrels used last year. In his survey Mr. Teagle says in part:

"New uses are continually being found for petroleum products. We know that the percentage of growth of the oil industry during the past thirty years has averaged 8.54 per cent. per annum. This may not seem a large figure by itself, but when one applies it to the quantities being consumed today, one realizes that it does not require a statistician to appreciate the magnitude of the problem of supply for the future. During the past year the United States has produced a little over 1,000,000 barrels a day of crude petroleum, a total of 376,000,000 barrels, according to the Government's preliminary figures. In addition to this there has been imported from Mexico about 60,000,000 barrels.

"The petroleum industry in this country, therefore, used during the last year a total of approximately 436,000,000 barrels. Apply 8.54 per cent. of increase and one has 37,235,000 barrels additional required during the present year in order to meet the increased demand based on actual figures of past experience.

"If this percentage of increase continues—and there is no reason to doubt that it will—then five years from now (in 1925) the petroleum industry in this country will need approximately 650,000,000 barrels, or an increase of 220,000,000 barrels, as compared with 1919."

New Anaesthetic Produced

Du Pont Product Has Many Qualities of Refined Ether

DEVELOPMENT of a new anaesthetic "which eliminates pain without loss of consciousness and produces virtually no nausea," has been announced by E. I. du Pont de Nemours & Co. The discovery, it is claimed, will permit elimination of pain not only in obstetrical cases and dressing of wounds, but in dentistry.

The anaesthetic is described as "a new type of ether—highly refined and modified by addition of certain gases which give to it these new and desirable characteristics.

CHEMICAL INVESTIGATION

Efficiency and Control

ALL classes of work covered by the following subjects will be done for readers of "The Chemical Engineer" through this department: special research of every description; analysis and reproduction of any commercial product; prevention of waste and utilization of by-products on the most economical basis; valuation of raw materials; food analysis, and disputed points in regard to adulteration, labeling, and the enforcement of pure food laws; bacteriological and enzymatic examinations, including fermentation tests, pure yeast cultures, beverages of all kinds; development of chemical inventions and industrial

processes; examinations and advice on special machinery. Inquiries of a minor character will be answered on this page, while major matters involving personal investigations, analyses, etc., will, if desired, be treated confidentially through the mails. All questions, materials for analysis, or letters leading to the opening of negotiations for special work will receive prompt attention if addressed to

Inquiry Department,
The Chemical Engineer, 118 East 28th Street,
New York City.

A. K.—Your samples of fuel were received in good condition and on being submitted to the test for calorific value gave the following results:

Anthracite	7,624
Cake	6,996
Lignite briquettes	4,875
Lignites	4,200

The binder in the briquettes was found to be sodium silicate.

E. L.—In conducting your analysis of the sodium silicofluoride I would recommend that you proceed by treating 1.0 gram of the powdered sample with excess of N/4 hydrochloric acid, using methyl orange as the indicator. Dilute with equal volume of water, and neutralize with N/4 potassium hydrate. Treat this neutral solution with N/4 potassium hydrate, this time using phenolphthalein as the indicator.

Calculate the sodium silicofluoride by the following formula.



W. E. O.—The wood substitute on chemical analysis has been found to contain:

	Parts.
Sawdust	100
Magnesia	38
Magnesium chloride	20

This is added in the form of a concentrated solution and the whole pressed into molds. These are next heated to 250-275° C., whereupon they quickly "set" into strong masses.

O. H. L.—"Colver on High Explosives" deals at length on the subject you mention. See page 537.

Z. O.—Indigo greys on the fabrics you mention are produced by a mechanical process. The dye is held to the cloth by simple adhesion.

The color is fast to both soap and boiling water.

V. M. H.—You may determine the specific gravity of your cereals by the toluene and pycnometer method. The formula is:

$$\text{Sp. Gr. of cereal} = \frac{\text{Sp. Gr. of the toluene} \times \text{weight of cereal.}}{\text{Weight of toluene displaced by cereal.}}$$

By this method, wheat shows a Sp. Gr. of about 1.40 at 20° C.

E. B. A.—Para-dichlorobenzene has, as you say, been used very extensively of late as an insect fumigant.

M. R. W.—B-naphthylmethylamine may be produced by heating B-naphthol and methylamine hydrochloride with sufficient 5/N sodium hydrate. I am mailing you a sketch of the type of autoclave required, with all other necessary data.

B. L. T.—The sample of oak leather submitted has been analyzed with the following result:

	Per Cent.
Moisture	5.9
Ash*	1.2
Oils	2.8
Tannin (free)	12.5
Tannin (combined)	26.8
Non-tannins	28.0
Albumin	4.7
Carbohydrates	18.1

* Contains 0.4 per cent. Epsom salts.

V. G. M.—The products called Aquadag and Oil-dag are collateral graphite lubricants. As these are patented materials, I would not advise you giving them any further consideration. If you wish to market a colloidal graphite, I can send you a perfected working formula on which there are no patent claims.

A. A. C.—Watkins' patent for grinding bodies for use in tube mills dispenses with the usual balls or pebbles and uses instead bars or tubes with slightly greater length than the diameter. The cross section of the bars or tubes is cruciform or ribbed and may or may not have a longitudinal twist.

Regarding the use of such patents, see the preceding answer.

S. E.—In answer to your letter asking for the name of a manufacturer who sells a two-speed motor centrifugal, I would advise you to write to S. S. Hepworth Co., 2 Rector street, New York City.

With the death of Mr. H. H. Weinlagen of the firm of Wienhagen & Hespe, manufacturers of chemical glassware and thermometers, New York City, the business of the partnership has been taken over by the surviving partner, Mr. A. T. Hespe. The present name of the firm will be retained.

In 1855 the business of the present firm of Weinlagen & Hespe was founded by H. Weinlagen who built up a large and successful business in a few years on the basis of certain patented improvements to the clinical thermometer. The founder of the business died ten years ago and it was taken over by a partnership made up of his son and Mr. A. T. Hespe.

DISTILLATES

Matters Pertaining to the Industries

I. Motor Spirit
By C. B. Davis

THIS important fuel comprises most of the lighter fractions of crude petroleum. Although products from other sources such as coal-tar and shale oil are consumed, it is the petroleum product of which this article will treat.

The lighter fractions of crude petroleum consist of cymogene (gas), rhigoline, petroleum ether and naphtha, all of which pass over at or below 150° C. Then the lighting and cooking oils, paraffin oil, petroleum jelly, and lastly asphalt, an oxidation product, are obtained.

To give perfect satisfaction, the characteristics of motor-spirit should be:

Boiling point of mixture, not over 100° C., and residue on evaporation at 200° C. not over 0.001 per cent. Specific gravity should not be over 0.720, and when distilled from a Ladenburg flask, with thermometer bulb just below the outlet tube, the first drop should appear at or below 64° C.

Distillation should then proceed with a uniform rise in temperature, without serious breaks, and all should pass over at or below 150° C.

The distillate should be water white, free of acidity and moisture.

Water, if present, will be found in those fractions passing over between 90° and 150° C. By receiving these in a graduated vessel, immersed in cracked melting ice, its volume is readily noted and the percentage calculated.

The fractional distillation is best carried out on 500 cc. of the spirit, contained in the flask above mentioned, and immersed in an oil bath, regulated in turn at the following temperatures: 50, 60, 70, 80, 90, 100, 125, 150, 175 and 200° C., collecting each fraction separately.

The total distillate, collected up to and including 100° C., is to be reported as motor-spirit, those between 100° and 150° C. as heavy naphtha, and those up to 200° C. as benzine or kerosene.

The greater the total content up to 100° C., the more valuable the spirit, since fractions above 100° C. and up to 200° C. will gradually deposit soot and fuel and foul the engine, due to not containing sufficient hydrogen and insufficient carbon.

A motor-spirit responding to the "doctor" test, or containing water, acid or fractions of more than one per cent. which boil above 150° C., should be rejected. In winter a greater percentage of low boiling oils is required and allowed than in summer.

Much of the consumed spirit now sold contains the higher fractions in various amounts. Between 1917 and 1919, although the lower fractions remained about constant, the final boiling points were higher, especially during the latter period.

Three distinct types of spirit are marketed—"straight refinery," "casing head" and "cracked or synthetic."

Total motor-spirit consumed during the period 1909-1918 increased from 13,000,000 to 70,000,000 barrels. The total in 1919 was 78,000,000 barrels.

It has been satisfactorily established that aromatic or unsaturated hydrocarbons, in this class of fuel, are as good as the non-aromatics. I mention here the analysis of aeroplane or aviation spirit, which consisted of 10 per cent. aromatic, 40 per cent. saturated cyclic and 50 per cent. acyclic hydrocarbons. This gave entire satisfaction during the war.

Many substances have been recommended of late to increase the efficiency or mileage. Among these are included ethyl and methyl alcohol, ethyl ether, acetylene, hydrogen, benzole and toluene, but from all accounts a low boiling point petroleum mixture, of the composition mentioned above, will meet the conditions required. Efficiency or mileage are dependent chiefly upon the weight of machine, type of motor, weather, etc.

Motor-spirit vapor and air, when ignited in the engine, produce a pressure of about six atmospheres and a temperature as high as 200° C. The limit of complete inflammability of this vapor and air mixture is respectively 1.5 to 6.0, and its calorific value about 20,300 B. T. U., developing 1.38 horsepower per pound of spirit.

In conclusion I wish to say that the conservation of this fuel in the future is more than a minor matter, due to the rapid depletion of our crude petroleum supply.

Co-operative Research

Prof. Adams Against Closed Door in Industrial Plants

THE importance to the country of co-operative research on the part of industries was urged by Prof. Comfort A. Adams in an address delivered at the convention of the Compressed Gas Manufacturers' Association, held at Rumford Hall, New York City. He pointed out the advantages that had resulted from such work during the war and asserted that the "closed door in industrial plants always shut out more than it shut in." The time when manufacturers should pursue a narrow and selfish policy in research, he said, was past, and through co-operation all would benefit.

Representatives of the Bureau of Explosives and of the Chemical Warfare Service, U. S. A., were also among the speakers, emphasizing the part played by the compressed gas manufacturers during the war. Major General W. I. Sibert, who was scheduled to speak, was unable to attend, but sent a representative. The remainder of the session was devoted to committee reports and routine business.

Research in Canada

Canadian Research Council Has Done Important Work During Year

IN reviewing the work done by the Canadian Honorary Advisory Council for Scientific and Industrial Research during the past year, Dr. A. B. Macallum, chairman of that organization, predicts that within the year it is likely that the Dominion of Canada will establish not only a national research organization similar to that of the Mellon Institute at Pittsburgh, but will also probably lay the foundation of another organization affiliated with it similar in many ways to the Bureau of Standards at Washington. Both these organizations are needed in Canada, according to Dr. Macallum, if Canada is to be in a position to compete on a parity with other industrial nations of the world. England, Germany and the United States already have national scientific research organizations, and Japan and Australia are busy forming others.

The Dominion Government has not yet adopted the recommendations the Council has made in regard to the establishment organization subsidized by the government, but during the last session of the Dominion Parliament a committee, after investigation, recommended the formation of a Canadian Bureau of Standards. Further steps aiming toward the formation of a national research organization will probably be taken during the coming year.

During the year past one of the most important tasks undertaken by the Council for Scientific and Industrial Research was its attempt to induce the Canadian Government to remove the restrictions which at present affect the manufacture of industrial alcohol in Canada. The Council believes that the cheaper industrial alcohol is in Canada the better it will be for a number of industries in Canada. Germany, it is pointed out, during the course of its campaign before the war, consumed about 100,000,000 gallons of industrial alcohol annually, and the United States in 1918 used 40,000,000 gallons. In 1917 the consumption in Canada was only 130,000 gallons. This small consumption was due to the fact that the restrictions on the manufacture of this product in Canada make it impossible to manufacture the material cheaply; industrial alcohol costs fifty per cent. more in Canada than it does in the United States, and twice as much as it does in Great Britain.

Should these restrictions be removed, it will be possible to build up in Canada a good-sized industrial alcohol industry, based upon the utilization of wood waste of all kinds. In British Columbia, on the western Canadian provinces, it is claimed by the members of the Council, wood waste sufficient

to form the basis for the manufacture of 50,000,000 gallons of alcohol is wasted annually.

Other research work fostered by the Council during the past twelve months has had to do with the best methods of utilizing the low grade iron ores which abound in certain localities in Canada, the utilization of the fish waste which as a by-product of the canneries is turned out to the amount of about 300,000 tons annually on the Atlantic and Pacific coasts of Canada, and the devising of methods of utilizing Canadian peat industrially.

The Council has given a grant to Prof. Stansfield, of McGill University, Montreal, a metallurgist of some note, to conduct inquiries into methods of smelting the low grade Canadian ores. At present ninety-six per cent. of the iron ore smelted in Canada is imported and the Canadian Council believes that Canada's own iron should be used in her blast furnaces.

Chiefly through the representations of the Council, a private organization financed by American capital for the greater part, established a plant at Canso, N. S., to utilize fish waste for the manufacture of cattle food and oil.

Two years ago the Council recommended that the Dominion Government establish an experimental plant for the briquetting of lignite at some central point in the western provinces where this material is plentiful. It was their claim that, properly treated, this material could be used for industrial purposes with almost as great ease as anthracite, a material which has to be imported by Canada from Pennsylvania.

As a direct result of these representations, the government at Ottawa, in conjunction with the provincial governments of Manitoba and Saskatchewan, authorized a grant of \$400,000, appointed a Lignite Utilization Board. This board established an experimental plant in Saskatchewan. This plant will be in full operation next August, will be turning out briquettes at the rate of 30,000 tons a year. These briquettes will be sold in Winnipeg at \$9.40 a ton, as against the price asked for anthracite of \$16.

Considerable work was also done in connection with the following subjects by the Council: The extraction of helium gas from the natural gases of Alberta, the utilization of ultraviolet rays in catalysis, and the investigation of the use of flotation processes in the separation of Canadian ores by waste oil from wood distillation.

The St. Louis, Mo., plant of Anheuser-Busch, Inc., will shortly manufacture malt sugar, malt syrup, soda fountain supplies and will purchase, cure and market hams and bacons. The brewery storage plants will be used as warehouses in connection with the distribution of these products.

The Electro Bleaching Gas Co., Niagara Falls, N. Y., has issued a booklet entitled "Liquid Chlorine," describing in a non-technical way chlorine gas and its uses.

Mainly About Companies Incorporations

American Gelatin Company of Buffalo has been incorporated with an active capital of \$240,000 by A. M. Payton, E. M. Fairchild, P. Capolano, Buffalo.

The manufacturing and selling of chemicals, perfumery, fats, oils, soaps, etc., are additional objects of the Paterson Brewing and Malting Company of Paterson, N. J., which has filed a certificate in New Jersey.

Alfred Joensson, Inc., 100 John street, an organization recently incorporated with a capital of \$1,000,000 for the purpose of dealing in crude drugs, spices, essential oils, etc., has taken over the firm of H. J. Macbeth, Inc., of this city.

Greeley Products Co. of Manhattan, makers of pine tree products, has been incorporated with a capital of \$150,000. Incorporators: R. Singer, M. Rothman, A. H. Greeley, Jr., 15 Park Row.

Standard Druggists Syndicate has been incorporated in Delaware with a capital of \$1,000,000. Incorporators: Henry D. Donne, Pasquale F. Arzillo, Somerville, Mass.; Vincent Nutile, Boston.

Neu-Metal Products Corporation, of Manhattan, oils and polishes, has been incorporated with a capital of \$100,000 by H. S. Percy, L. Feldman, B. Poring, 48 East 104th street.

The Ciomo Chemical Corporation has been formed in Delaware with a capital of \$100,000 by J. H. Marsten, A. Madison, L. Frank, all of New York.

Crown Point Spar Company, of Manhattan, feldspar and mica, has been incorporated by D. D. and H. Donager, E. M. Cummings, 663 Broadway.

Monroe-Louisiana Carbon Co. has been incorporated with a capital of \$500,000 by Thomas B. and Carroll Harlan and M. L. Adams of St. Louis, Mo.

The J. C. Scudder Son Company, of Buffalo, soaps, has been incorporated with a capital of \$50,000 by W. E. and J. L. and G. W. Branch, Lockport.

The National Pulp, Paper and Cordage Company, Inc., has been incorporated under the laws of Delaware by Rodney Hughes, S. S. Bagot and John W. St. Pierre of New Orleans, La., with a capital of \$500,000 to deal in dyestuffs, etc.

Luvein Laboratory of Manhattan, drugs and chemicals, has been incorporated with a capital of \$50,000 by W. H. & J. D. Lucas and G. P. Clauss, 990 Putnam Ave., Brooklyn, N. Y.

The Pittsburgh Chemical Products Co. of Pittsburgh, Pa., has applied for a charter to manufacture chemicals. A. H. Kaufman is solicitors for the applicants.

Cavendish Chemical Corporation of Manhattan has been incorporated with a capital of \$25,000 by G. Caminez, M. J. Cogan, B. V. Fine, 1 East 107th street.

American Nut and Seed Oil Corporation of Manhattan has been incorporated with an active capital of \$400,000. Incorporators: L. Bleich, W. A. Werner, W. P. Riley, 2 Rector street.

The Wags Chemical Company has been organized in Knoxville, Tenn., to manufacture soap and salves. It is capitalized at \$100,000.

The Chartered Chemical Works, Inc., Brooklyn, N. Y., has been incorporated with an authorized capital of \$1,000,000, to carry on a chemical manufacturing business.

Reliable Chemical Products Corporation has been incorporated in Delaware with a capital of \$100,000.

Eckerd Cut Rate Medicine Co., of Jamestown, has been incorporated under the laws of New York with a capital of \$75,000. Incorporators: J. M. and N. F. Eckerd, E. R. Hewitt, Jamestown.

Holmes Chemical Co., of Manhattan, has been incorporated with a capital of \$200,000. Incorporators: J. H. Sencindiver, A. W. Palmer, L. A. Anderson, 27 Cedar street.

Organo-Synthetic Corporation of Brooklyn, drugs, etc., has been incorporated with a capital of \$25,000 by F. J. and R. M. and E. G. Steinbugler, 16 Lenox road.

The Holmes Chemical Company of Manhattan, N. Y., has been incorporated with a capital of \$200,000 by A. W. Palmer and L. A. Anderson, 27 Cedar Street, New York City.

The Thatcher Process Co. of Syracuse, N. Y., has been incorporated with an authorized capital of \$100,000, by B. I. Cooper, E. H. Robertson and J. D. Grant, all of

Syracuse, N. Y. The company will manufacture anthraquinone by an electrochemical process invented by Dr. G. J. Thatcher.

The Aniline Dyes and Chemical Foundation, New York, has been incorporated to do business in the state of Illinois by A. F. Michenstein of Manhattan, N. Y. The capital stock is \$800,000. The company's principal place of business will be 297 Huron Street, Chicago.

The Cain-Leis Paint & Varnish Company, of St. Louis, has changed its name to the Leis-Morgan Paint & Varnish Company. L. E. Dean, R. A. Alsop and H. B. Sappington, Jr., were admitted to the firm as stockholders. The officers are George K. Leis, president; John F. Landolt, vice president; Hugh B. Sappington, Jr., treasurer and sales manager.

The British-American Chemical Company, of Jersey City, has filed with the New Jersey Secretary of State notice of increase of its capital stock to \$2,750,000.

Superior Printing Ink Company has been incorporated with a capital of \$40,000. Incorporators, H. G. and R. Krieger, J. Zucker, 1,288 Hoe avenue, Bronx.

Construction

The new plant of the Birmingham Coke & By-Products Co. of Birmingham, Ala., is nearing completion. It is expected that by March 1 the plant will be producing tar, benzol, sulphate of ammonia, etc.

The General Chemical Co. has let contracts to the J. G. White Engineering Co. for improvements to its plant at Marcus Hook, Pa.

A plant to cost two million is to be erected at Curtis Bay, outside Baltimore, Md., by the Sterno Corporation, a recently incorporated organization affiliated with the United States Industrial Alcohol Corporation. The corporation will manufacture alcohol burning devices for automobiles and boats.

The Consumers Dyewood Products Corporation will install a plant at Choctaw Point, near Mobile, Ala., to manufacture dyes in crystal form, according to a dispatch from Mobile.

The Savannah Creosoting Co. will erect a creosoting plant at Port Wentworth, Ga. The offices of the company are in Savannah, Ga., and F. S. Bishop is general manager.

The Farmers' Co-operative Phosphate & Fertilizer Co., Inc., with a capital of \$5,000,000 (authorized) will erect a plant at Mulberry, Fla.

J. Tyson & Son, manufacturers of fertilizers, Frederick, Md., are extending their present plant.

Financial

At annual meeting of stockholders of National Aniline Chemical Co. the four vacancies on the board were not filled and the board was reduced from sixteen to twelve members. Other directors were re-elected.

Hercules Powder Co. has issued its annual report for the year ended Dec. 31, 1919, and shows net earnings after all charges and taxes of \$1,579,794, equivalent after deduction of preferred dividends to \$16.85 a share (\$100 par value) on the \$7,150,000 common stock as compared with net of \$2,315,603 or \$27.15 a share in 1918.

Judge Julius M. Mayer in the U. S. District Court, New York, made an order approving the final adjustment of claims under contract between the receivers of the Aetna Explosives Co., Inc., and the U. S. Government totaling \$3,266,218 and of similar contracts with the Government of France amounting to \$241,425, which were enforced at the time the armistice was signed and which were subsequently modified.

Mr. John F. Queeny was elected chairman of the board of the Monsanto Chemical Works at the annual meeting of the shareholders of the company held in St. Louis. Mr. Gaston Du Bois was elected president and Mr. Howard O. McDonough vice-president. Mr. Edward M. Queeny was elected secretary.

New Offices

The Philadelphia Textile Machinery Co. announces the opening of a New York office at 291 Broadway, in charge of Mr. H. S. Landell.

Laidlaw, Kelley & Co., Inc., 14 Platt Street, New York City, will remove to larger quarters, 17-19 Thompson Street, on March 1. All departments of the organization will then be under one roof.

Mainly About Chemists

Mr. David F. Gould, formerly assistant chemist in the research laboratory of the Mexican Petroleum Corporation, Destrehan, La., is now research chemist with the chemical department of the Barrett Company, Frankford, Pa.

Mr. Arthur L. Stern has resigned from his position as research engineer with the Pennsylvania Trojan Powder Company of Allentown, Pa., and is now with the Max Marx Color & Chemical Company of Irvington, N. J.

Mr. Chester G. Gilbert, economic geologist and mining engineer, formerly of the Smithsonian Institution, has joined the staff of Arthur D. Little, Inc., of Cambridge, Mass., and is in charge of their Washington office in the Munsey Building. Mr. Gilbert will include economic surveys of land areas in his work.

Mr. W. Rowland Collins, formerly with the Wilckes Martin Wilckes Co., Camden, N. J., is now chemist for the Royal Baking Powder Co., at their Chicago factory.

Mr. E. M. Bissonette, formerly with E. I. du Pont de Nemours & Co., at their dye plant at Deepwater Point, N. J., where he was in charge of the manufacture of naphthalene intermediates, is now with the Atlantic Refining Company, Pittsburgh, Pa.

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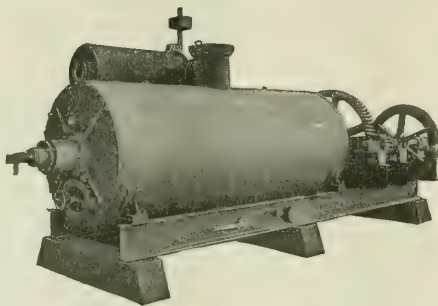
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C. W. BUTTERWORTH
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No. 3

The Situation in the Dye Industry

AT the time of writing, it seems that the passage of the legislation which would give adequate protection to the dye industry of this country, has been indefinitely postponed. After eliminating the increased duties provided in the Longworth Bill as it passed the House of Representatives last September, the Senate Finance Committee substituted for the licensing system proposed by the bill in its original form, an embargo to be administered by the Tariff Commission. The Tariff Commission was also empowered to permit the importation of such coal tar products as were found to be unobtainable in the United States or could not be obtained on reasonable terms as to price, quality and delivery.

Before issuing an import license the Tariff Commission must establish the fact that neither the article nor a satisfactory substitute is available in the United States or any of its possession on reasonable terms as to quality, price or delivery. To determine whether the article is of reasonable quality it must subject it to tests and ascertain whether it gives results in actual use substantially equal to a corresponding article of foreign origin. This will require extensive laboratory equipment and a staff of chemical experts to make comparative tests of dyestuffs, explosives and drugs of both American and foreign manufacture. The Tariff Commission must also pass upon the question of reasonable price, which is defined as the lowest price sufficient to insure the maintenance of an efficient plant operating on a substantial commercial scale. This, it is said, will require a series of elaborate efficiency surveys of the plants handling coal tar products and a well-organized system of cost accounting.

The whole administrative machinery connected with the embargo is to be operated by the Tariff Commission, which has the final word in determining the articles which may be imported. Many of the high-tariff Senators object to the embargo on account of the large discretionary powers vested in the commission, and announce a preference for the simpler method of temporary prohibitive duties. Such duties will serve to demonstrate the article that can be produced with a reasonable amount of protection and on the basis of the information thus

obtained the tariff rates can then be readjusted. This view is shared by Senators Penrose and Smoot.

Such, roughly speaking, is the dye bill as it stands. Since late in February its further consideration has been held up by the debate in connection with the peace treaty—a debate which seems to be about to terminate in a deadlock.

Yet, interminable as the debate on the treaty promises to be, there are signs already on the political horizon, that the debate on the dye legislation is to be almost as extended. Already the matter of protection of the dye industry of this country has been under discussion in the Congress since May last—almost a year. Yet it can almost be said that Congress seems to be about where it started. To strengthen this impression comes the announcement that it is the intention of certain senators, aiming to placate the textile interests, to introduce further amendments to the bill as it now stands when it again comes up for discussion in the Senate. From the beginning the fundamental question at issue has been deliberately obscured in certain quarters, by the introduction into the discussion of questions more of a political than of an economic nature. The essential question after all is, How is the American dye industry to be protected in such a way against the possible competition of foreign countries that it will be able within a reasonable period of time to be in a position to supply American dye consumers with all the dyes they need? At this late date it is hardly necessary to attempt to show why it is necessary that American consumers should use American dyes: our wartime experience should be fresh enough in our memories to remind us of the importance of this if not from an industrial standpoint, at least from the standpoint of preparedness.

American manufacturers of dyes have succeeded in producing a great many dyes which are equal to and in many cases superior to the German product of pre-war days. They are today able to manufacture these dyes in ample quantity, sufficient at least to supply the domestic market and leave something over for export.

It must be frankly admitted that in the case of some dyes the American product is not entirely sat-

isfactory and is not equal to the German product of the same kind.

So far as a third class of dyes are concerned, it must also be frankly acknowledged that they have not been produced at all; their production demands heavy outlay for equipment and further research, involving the expenditure of large sums of money. But it must be remembered so far as this class of dyes is concerned, that there is no question about the ability of American manufacturers to eventually produce them in quantities quite sufficient for the country's needs.

The pending legislation at Washington has been bandied about in Washington, principally it would appear because no bill could be offered which would satisfy all concerned: the dye manufacturers apparently pulled one way and the consumers the other. And this sort of thing, so far as it is possible to see at the moment is likely to continue.

But do dye consumers who are offering objections of one kind or another to the passage of the proposed dye protection bill, fully recognizing what the result of such opposition is likely to eventually be? Do they recognize that unless the dye industry of this country is given protection, and adequate protection, and that as soon as possible, the likelihood is that within a year or so, they will find themselves so far as their supply of dyes is concerned, again at the mercy of a foreign producer? Do they recognize that in the present condition of the world outside America, such a dependence will be infinitely more serious than it was before the outbreak of the great war?

What seems to be needed most today, so far as the dye industry of this country is concerned, is more candor on the part of the American manufacturer, and more support on the part of his customer, the user of dyes. A frank admission of the difficulties of the task of duplicating many of the dyes heretofore manufactured in Germany, and an equally candid explanation of the steps that are being taken to overcome these difficulties, will, we are inclined to believe, contribute materially toward the winning of the consumers' support. If both manufacturer and user pull together it should not be so difficult to win through at Washington, and to obtain the support from the dye using industries which would make the carrying out of protective legislation successful.

Colloidal Clay and Soap

RECENT newspaper reports have told of the proposal aired in British scientific circles to utilize colloidal clays in the manufacture of soap. In another part of this issue will be found an article reprinted from our English contemporary *The Chemical Age*. Written by Mr. F. E. Weston, an acknowledged authority on the chemistry of oils and fats, it has attracted a great deal of attention

among technical men on the other side of the water and is here reprinted in our desire to give our readers some conception of the scope of Mr. Weston's suggestions and the researches upon which they are grounded. While we do not wish to be placed in the position of endorsing his suggestions, we regard them as sufficiently important to warrant the closest study on the part of those interested in the technology of soap.

As every chemist knows, commercial soaps are either the sodium salts or potassium salts of fatty acids of comparatively high molecular weight. The soaps ingredients are obtained usually from animal or vegetable fats, which are treated with caustic soda to obtain glycerol. Pure commercial soaps contain some thirty percent. of water and from sixty to sixty-five per cent. of fatty acids. It is the cost of these fatty acids which makes the price of soap so high these days.

According to Mr. Weston, colloidal clays when incorporated into soap, up to a certain point, form a substitute for pure soap, and in fact increases the detergent qualities of the final product considerably. While Mr. Weston does not claim that the fatty acids can be done away with entirely, he believes that the use of colloidal clays should make it possible to reduce the final cost of soap materially.

We present Mr. Weston's article for what it is worth, merely remarking that no matter what the final fate of the ideas he gives expression to may be, they nevertheless serve to suggest some of the possibilities of colloid chemistry—the next world for industrial chemical science to conquer.

Another Gasoline Substitute

SOME very interesting facts in regard to a substitute for gasoline made with alcohol distilled from molasses have been published by the Cuban Secretary of Agriculture. This article is based upon a report to the Planters' Association made by the Agricultural Company of Maui. It refers to a recent scarcity of gasoline in Hawaii, saying that if the war had lasted one or two years longer, the islands would have been deprived entirely of gasoline, says the "Louisiana Planter and Sugar Manufacturer."

A large portion of the molasses produced yearly is now entirely lost. Only 60 per cent. of the total production in 1918, of approximately 150,000 tons, were sold. Of this quantity 8,000,000 gallons could be used as fuel. The medium price in 1918 was only \$7 a ton, or 4 cents per gallon, when, as a substitute for gasoline, each ton is, by the process of the Maui Company, of a much higher price.

Of the remaining molasses, 8 per cent. was thrown away, 10 per cent. was burned to obtain potash, 15 per cent. was consumed as fuel and 7 per cent. was stored to be fed to cattle.

When used for producing a substitute for gasoline by the Maui Company's process, its value is

from \$12 to \$13 per short ton, and it leaves a residue that will, if quickly applied, fertilize the cane fields, thereby reducing the cost of cultivation, as it retains all the potash of the molasses, all the phosphoric acid, and also some nitrogen.

The Maui Company produces 350 gallons of this alcohol daily, with only three men, and claims that a plant to produce 3,000 gallons per day would need no larger force.

The alcohol modified as a substitute for gasoline, has been produced in considerable quantities by the Maui Company, and has been submitted to a number of trials, all of which gave excellent results. It left no deposit of carbon, but also cleaned the cylinders of the machines in which it was tried of the carbon left there by gasoline. The machines ran with less vibration, with less lubrication, and at a higher uniform velocity with the same opening of the valve that obtained with gasoline.

It was also noted that greater power was developed than with an equal quantity of gasoline. Much of this was beyond all room for doubt, due to the elimination of carbon deposit, which is caused by the formation of steam, from the water in the alcohol, and also that produced by combustion; resulting in a smoother operation and higher efficiency of the machine. The method of making the substitute with completely denatured alcohol is as follows:

To one hundred gallons of alcohol, add five gallons of ether, two gallons of benzine and one gallon of lepyridine. Sulphuric ether can easily be obtained and at a low price; and the expense of denaturing will be effected by the cost of the ether, which will be in its turn controlled by the cost of the alcohol.

The price of molasses is variable, and the cost of distilling depends upon the capacity of the still, and the situation and, for these reasons, the price of the alcohol cannot be given with exactitude.

A still operated with or in connection with a sugar factory can be run at much less expense than one apart, in any other place. With one of a thousand gallons capacity per day, the cost of distribution will not exceed four cents per gallon, excluding the cost of raw material. Ether will cost 30 cents per gallon, and the proportion that will give the greatest satisfaction is from 20 to 25 per cent. We have then, at present, as the cost of denaturing 100 hundred gallons of alcohol: Two gallons of benzine at 60 cents, \$1.20; one gallon of pyridine at \$1.75, \$1.75; twenty-five gallons of ether at 8 cents, \$2; equal to 128 gallons of substitute, \$4.95.

The Future of Oil

THERE is still no let up in the production of oil companies, according to the record of incorporations. During the month of February 211 new enterprises were started to engage in the petroleum industry. In other words there were more oil com-

panies formed in the month of February than in any month since 1914. But the importance of the aggregate number of companies is somewhat minimized by the fact that their total capitalization is smaller than it was during recent months; while there were more companies formed, their average size was smaller.

As to whether or not this presages an approaching end of the oil "boom," authorities differ. If any conclusions can be drawn from statistics of this kind, they should at least be based upon the totals of several months, not upon the record of a single month. Even the least optimistic of "experts" could be excused if they held that after all talk of a "boom" is rather unwise in the face of the present situation in the petroleum industry: a situation which calls forth a warning such as George Otis Smith, director of the United States Geological Survey recently uttered.

There is need for the strict conservation of oil supplies in the United States. The domestic consumption of 1918 took more than one twentieth of the unrecovered oil supply of the United States and nearly one fifth of the oil stored above ground.

The demand for petroleum products is undoubtedly increasing. The consumption of lubricating oils by pleasure cars, motor trucks and tractors is estimated at almost 200,000,000 gallons a year. The United States army peace time requirements call for 88,000,000 gallons of gasoline, fuel oil, lubricating oil and kerosene a year. New demand for the country's shipping program is equal to nearly one-half the domestic output of fuel oil and unless there is a decrease in other requirements, an increase in production of nearly 200,000,000 barrels of crude must be obtained.

In the face of these facts who can help but be a "bull" in regard to oil!

An English Optimist

LORD LEVERHULME, head of Lever Brothers, the English soap manufacturers, returning to England recently after his fortieth visit to the United States, said that the man "who doesn't go 'bull' on the United States will die broken-hearted."

In view of Lord Leverhulme's large "stake" in this country, his "bullishness" in regard to the United States, is not unwelcome, in these days of uncertainty.

Reports from Edmonton, Province of Alberta, Canada, stated that Frank Perry, an explorer, who has spent fourteen years exploring the Mackenzie River and adjacent river valleys of that country, is planning to come to this city for the purpose of interesting capitalists in the development of immense beds of potash and other minerals he says he has discovered in the Mackenzie River basin. The minerals include coal, gold, platinum and others.

A Home for the Council

THE Carnegie Corporation of New York has announced its purpose to give \$5,000,000 for the use of the National Academy of Sciences and the National Research Council. It is understood that a portion of the money will be used to erect in Washington a home of suitable architectural dignity for the two beneficiary organizations. The remainder will be placed in the hands of the Academy, which enjoys a federal charter, to be used as a permanent endowment for the National Research Council. This impressive gift is a fitting supplement to Mr. Carnegie's great contributions to science and industry.

The Council is a democratic organization based upon some forty of the great scientific and engineering societies of the country, which elect delegates to its constituent divisions. It is not supported or controlled by the government, differing in this respect from other similar organizations established since the beginning of the war in England, Italy, Japan, Canada and Australia. It intends, if possible, to achieve in a democracy and by democratic methods the great scientific results which the Germans achieved by autocratic methods in an autocracy while avoiding the obnoxious features of the autocratic regime.

The Council was organized in 1916 as a measure of national preparedness, and its efforts during the war were mostly confined to assisting the government in the solution of pressing war-time problems involving scientific investigation. Reorganized since the war on a peace-time footing, it is now attempting to stimulate and promote scientific research in agriculture, medicine and industry, and in every field of pure science. The war afforded a convincing demonstration of the dependence of modern nations upon scientific achievement, and nothing is more certain than that the United States will ultimately fall behind in its competition with the other great peoples of the world unless there be persistent and energetic effort expended to foster scientific discovery.

Molybdenum in Demand

THE recent discovery of a valuable molybdenum steel alloy by a British metallurgist has resulted in an increased demand for molybdenum at an enhanced price. Over \$3,000 per ton has been quoted for it. It is, however, a rare metal and difficult to obtain. There are large low grade deposits of the mineral molybdenite, from which the metal molybdenum is obtained in Australia, India, South Africa and Peru. It is estimated that Peruvian mines are producing nearly 80 per cent. of the world's molybdenum ores at present.

Peruvian molybdenite deposits are worked at Rican, in the Department of Junin. The average

yield is about 5 per cent. molybdenite per ton of gauge rock.

These deposits were first mined in 1915. They are now being actively exploited by American capitalists, who export all the ores mined to the United States, where the metal is principally used as an element of alloys.

Fertilizer Shortage Probable

SHORTAGE of fertilizers for the coming season is becoming more apparent and there are those in the industry who predict that many consumers will be forced to content themselves with short allotments. The situation is rendered the more difficult in the face of the fact that in many districts in the United States the soil is badly in need of fertilizer, little or no fertilizer having in a great many cases been used for years.

The Alsatian shipments have been small, and German potash still seems out of the question. Germany is in no condition apparently to ship any quantity of potash, on account of the serious coal shortage in Germany and the difficulty of obtaining means of transportation. Chilean shipments have been small lately on account of the lack of ships.

The improved situation so far as phosphate, both rock and acid, is concerned is the one bright spot in another big gloomy outlook: labor troubles for some time curtailed the production of rock, but we understand that these have been settled and the production is increasing.

Those who will during the coming year suffer as the result of the expected potash shortage will have the Administration at Washington to thank as well as their own desire to take advantage of the large shipments of potash they expected would arrive from Germany as soon as the effect of the signing of the armistice was felt. When peace came the domestic potash industry was beginning to find its feet after a long struggle but the refusal of American consumers to buy and the apparent indifference of the Administration to its fate, brought a serious set back. During 1919 most of the potash plants closed down with the result that today it is unlikely that American producers will be able to turn out much more than 25,000 tons before May 1.

Every support should be given the movement backed by the American Forestry Association which aims at the taking of a survey of the pulpwood situation on the part of the Government at Washington. As Mr. Charles L. Pack, the president of this association, recently pointed out, this country must sooner or later adopt a national forestry policy, and the sooner the better. An adequate supply of paper is at the basis of a good many industries in this country and both this adequate supply and a national policy, can best be based upon a survey intelligently conceived and thoroughly made.

Colloidal Clay in Soap Manufacture

The Use of Colloidal Clay in Soap Not Only Reduces the Cost of the Commodity Materially According to an English Chemist, But Increases the Detergent Qualities of the Soap

By F. E. WESTON, B.Sc., F.I.C.

COLLOIDAL chemistry—a branch of chemistry of modern growth—has revealed much in technological processes that was formerly little understood, and has brought many processes that were of an empirical nature (and, therefore, more or less a matter of uncertainty as to their success) into the realm of certainty. Processes have been devised whereby substances, formerly classed as insoluble bodies in water, may be prepared in such a fine state of division as to enable them to be so dispersed in water that they produce colloidal solutions. Two notable instances of such bodies are silver and mercury, the colloidal solutions of which find valuable applications in medicine.

Clay, a substance possessing marked physical properties distinguishing it from most other mineral bodies, has generally been regarded as of a colloidal nature, but it is only in recent years that it has been shown to be a true colloid inasmuch as clay is now obtainable in such a fine state of division that true colloidal solutions can be made therefrom. This colloidal clay belongs to the general class of “suspensoids,” and is a reversible colloid, since it is possible to disperse it in water, or throw it out of colloidal solution at will.

True colloidal clay is prepared from China clay—a product in which this country is very rich—also a mineral that has found very many technical applications besides the very important one of porcelain manufacture. It can, however, be confidently asserted that the uses to which colloidal clay is already being put, and will in the future be applied, far transcends in importance any of the ordinary processes for which China clay is now used. One of the many and varied applications of colloidal clay is that of its use as an adjunct in the manufacture of soap. In this connection colloidal clay is not to be looked upon as a “filling” material for soap, nor as an adulterant, *but as an actual substitute for soap material*. As this statement is contrary to usually accepted conceptions of what soap is, and is of a revolutionary nature it is as well to discuss the matter in greater detail.

It may be asked, What is soap? Chemically, soap is a mixture of sodium or potassium salts of fatty acids obtained from the fixed oils or fats of animal or vegetable origin, or even from rosin: but, so far as the writer is aware, no satisfactory definition of the action of soap in washing and cleansing has yet been given.

The work soap does in washing and cleansing can only be satisfactorily explained by the laws of col-

loidal chemistry. Ostwald's conclusions are that in the process of washing colloidal chemical processes of all kinds take place, but that adsorption phenomena in particular play a very great part. Spring, who investigated the subject very fully, has also shown that adsorption is an important property of colloidal bodies, and that soap is adsorbed by many substances, and in the case of soot he was able to obtain adsorption complexes of soot and soap which passed through filter paper. He also arrived at the conclusion that the concentration of soap on the surfaces of the adsorbing bodies is the chief factor in the detergent action of soap. According to Michaelis adsorption is the greatest for those substances which produce the greatest lowering of the surface tension of a liquid when in solution in that liquid.

It is well known that soap, when dissolved in water, considerably lowers the surface tension of the water against air, and is, therefore, greatly adsorbed by other bodies. Other properties possessed by soap are its power of raising the viscosity of water, and its great emulsifying action on other bodies. There are many substances which, when dissolved, lower the surface tension of water against air, and whose solutions produce lather, but they do not possess the emulsifying power of soap. Moreover, unlike soap, they do not raise the viscosity of water so as to produce surface layers of marked rigidity, nor do they possess detergent properties. Clay, like soap, possesses the property of absorbing other materials to a marked degree; but what is not generally known is that clay can be brought to such a highly colloidal state that it closely resembles soap in its physical behavior. Such colloidal clay when properly incorporated with soap actually increases the lathering and detergent properties of the latter, probably owing to the formation of a homogeneous mixture, namely, a solid solution, both being of a highly colloidal nature.

Below a certain concentration a solution of soap in water will not lather owing to the surface tension of the liquid not being sufficiently reduced to form a foam. Also, if to a solution of soap that will produce a lather on shaking more than a certain maximum quantity of alkali be added, the lather is destroyed owing to the soap coagulating or salting out.

To a suspension of colloidal clay in water add a certain amount of alkali, say, sodium carbonate, the clay disperses through the water and forms a colloidal solution, producing a more or less viscous liquid depending upon the amount of clay dispersed;

in the case of a colloidal solution, containing 40 per cent. of colloidal clay the liquid has the consistency of thick cream. Add to a colloidal solution of clay an amount of alkali in excess of the maximum required to produce colloidal dispersion and the clay coagulates or swells and settles out.

Chemically, soap and clay belong to two distinct types of compounds, soap being a sodium salt of a fatty acid, whilst clay is an aluminum salt of silicic acid, or hydrated aluminum silicate. Physically, however, the solutions of these bodies resemble each other closely, viz., their surface tensions are lower than that of water, their viscosities are greater, they both possess emulsifying power, both have the power of adsorbing dirt, grease, &c., to a marked extent, and both have detergent properties.

The following experiments were carried out with a view to comparing the lowering of the surface tension of water by various substances with that produced by colloidal clay. So far it has not been possible to measure the surface tension of a solid against air or against a liquid, but by the use of colloidal clay it is possible to measure, by the capillary method the surface tension of equal parts of colloidal clay and water against air. The following results were obtained by the capillary method:—

Liquid.	Surface tension.		
	At 21°C.	At 45°C.	At 95°C.
1. Water	Gm. cms. 0.07205	Gm. cms. 0.06874	Gm. cms. 0.06116
2. 0.125 gm. sodium carbonate + 125 c.c. water	0.07127	0.06825	0.06096
3. 1 gm. sodium carbonate + 100 c.c. water	0.05765	...	...
4. 0.5 gm. aluminium sulphate + 250 c.c. water	0.06924	...	...
5. Saturated solution of lime water	0.06597	...	...
6. 7.45 gm. colloidal clay, 0.125 gm. sodium carbonate, 250 c.c. water	0.07013	0.06791	0.06013
7. 50 gm. colloidal clay, 0.5 gm. sodium carbonate, 50 gm. water	0.04279	...	...

It is thus seen that colloidal clay has a marked action on lowering the surface tension of water.

When incorporated with soap colloidal clay also tends to lower the surface tension of water to a greater extent than soap itself. The following experiments were carried out with a high class toilet soap (A) and a soap made up of 80 per cent. soap A + 20 per cent. colloidal clay (B).

Liquid.	Surface tension.	
	At 20°C.	At 45°C.
1. 0.5 gm. sample A, made up to 100 c.c. of solution with water	Gm. cms. 0.02422	Gm. cms. 0.02215
2. 0.5 gm. sample B, made up to 100 c.c. of solution with water	0.02200	0.02062

It will be noted that the soap containing colloidal clay lowers the surface tension 9.1 per cent. and 6.9 per cent. more than the pure soap at 20 C. and 45 C., respectively.

Since the lathering properties of a soap increase with the lowering of the surface tension it is interesting to note the effect on the formation of lather by colloidal clay when added to a soap. It is also well known that the lathering and detergent properties of a soap are increased by the addition of alkalies in moderate amount, hence the following experiments were carried out. A solution was prepared containing 0.125 gram of sodium oleate in 100 c.c. of solution in water. 10 c.c. of this solution was mixed in a 50 c.c. graduated stoppered cylinder with 10 c.c. of normal soda solution. The mixture was then shaken backwards and forwards 20 times in 10 seconds and allowed to stand, when the volume of lather (a) and the volume of solution were read. A similar solution was made in another graduated cylinder, but with the addition of 0.01 gram of colloidal clay and the operations were repeated.

Lathering Experiments

	10 c.c. sodium oleate + 10 c.c. normal soda.		10 c.c. sodium oleate + 10 c.c. normal soda + 0.01 gm. C. clay	
	(a)	(b)	(a)	(b)
1	16.0 c.c.	18.0 c.c.	19.8 c.c.	15.2 c.c.
2	16.0 "	17.0 "	20.7 "	14.8 "
3	16.3 "	17.2 "	21.6 "	14.9 "
4	17.0 "	17.0 "	21.6 "	14.9 "

These results, one of many series, show that the lather obtained by adding colloidal clay to the soap is much greater than that obtained by the soap itself; moreover, in all cases the lather is of a firmer nature and is more persistent. It should also be noted that a larger quantity of water is converted into lather by the colloidal clay soap than by the pure soap. Experiments show that the amount of colloidal clay soap required to convert a given quantity of water completely into lather is about 60 per cent. of that required when using soap only. A further instructive experiment on lathering is the following:—The sodium oleate was diluted with distilled water till on shaking no permanent lather was produced; a minute pinch of colloidal clay was then added, when on shaking a persistent lather was obtained.

Although alkalies are useful in increasing the lathering and detergent properties of soap they are extremely unpleasant to the human skin and very deleterious and harmful to textiles. Colloidal clay on the other hand, being a perfectly neutral substance, is not only harmless to the skin and textiles, but it is actually beneficial to the skin, acting as an emollient and a germicide. In fact, a patent was taken out by Dr. Langheld, who attempted to cover the use of finely divided clay in preparations to be used as antiseptics for the skin.

Owing to the highly adsorptive properties of colloidal clay the presence of small quantities of alkali in the soap with which it is admixed is permissible since this will be mostly adsorbed by the clay and, therefore, rendered harmless. Several experiments

have been carried out on the adsorption of alkalis by colloidal clay, of which the following is typical. To several portions of 6 grams of colloidal clay contained in large test tubes varying amounts of sodium carbonate were added and then 30 c.c. of water. After thorough agitation for one minute the tubes were allowed to stand overnight. Five c.c. of the supernatant liquid were then withdrawn from the tube and titrated with standard acid, and the amount of sodium carbonate found in the solution was calculated to the total 30 c.c. of original solution.

Expt.	Water added.	Sodium carbonate added.	Sod. carb. found (total).	Sodium carbonate adsorbed.	Per cent. adsorbed.
	c.c.	Gram.	Gram.	Gram.	
1	30	0.3	0.248	0.052	17
2	30	0.18	0.146	0.034	19
3	30	0.12	0.092	0.028	23
4	30	0.09	0.041	0.010	32
5	30	0.03	0.019	0.011	36

The above indicate the usual results obtained in absorption experiments, namely, the percentage of adsorption decreases with the increase in the concentration of the body absorbed.

Colloidal clay resembles soap in its power of emulsification. "An emulsion in the strict sense of the term is a system of two practically insoluble liquids, one of which is distributed in the other in the shape of small drops" (Willows and Hatschek). Pickering, however, has shown that emulsions can be obtained with oil and water if a third body is present which is insoluble in both oil and water, and Clowes has demonstrated that the emulsion may be either one of oil in water or water in oil,

depending upon the relative amounts of oil, water and insoluble body. As an example of the emulsifying power of colloidal clay the following experiment is typical:—To 5 parts by weight of paraffin is added 0.5 parts by weight of colloidal clay; on shaking and allowing to stand the clay settles out. On slowly adding warm distilled water and shaking, the whole mass suddenly swells and becomes viscous. When 5.5 parts of water have been added, and after standing a very small quantity of water separates, leaving above it an emulsion of clay, water and oil.

As regards the detergent properties of clay it is well known that grease and dirt are easily removed from the hands when rubbed with clay and water, and many experiments have demonstrated that colloidal clay soap has far greater detergent properties than ordinary soap. It is the custom commercially to take as the criterion of a soap the percentage of fatty acids contained in the soap since they are a measure of the actual soap substance present. The higher the percentage of fatty acids found the higher the percentage of soap substance present. This criterion will no longer hold since colloidal clay contains no fatty acids and, therefore, the determination of these will not afford any information as to the lathering and detergent properties of the soap examined.

The importance of colloidal chemistry in its application to industrial problems is only just beginning to be realized. This wonderful branch of chemistry is still in its infancy, but it is now appreciated that the applications to which colloidal clay can be put are infinite, fresh discoveries being made almost daily.

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Canadian Epsom and Glauber's Salt Deposits

DEPOSITS of epsom and Glauber's salts which are of remarkable purity and size have recently been discovered in Canada.

Magnesium sulphate (epsom salt) has hitherto been imported into Canada for the tanning and textile industries and for medicinal use, largely from Germany before the war, and since increasing quantities from the United States.

The necessity of further imports seems improbable, however, as the deposits of magnesium sulphate at Basque, B. C., are announced to be 21,000,000 tons.

The product has already been introduced to Canadian tanners. The mining operations are comparatively simple. Rollers and drying apparatus are all that are required to prepare the product for the market.

The deposits are located at Epsom Spur, about three miles from the station, consisting of five lakes, the largest of which covers about eight acres, and the smallest is two acres in extent. The lakes are

1,500 feet above the railway and 2,500 feet above sea level.

Borings have been made in Lake No. 1 and at a depth of forty feet the drill was still in epsom salt. It has not been ascertained to what grater depth the deposit extends. It is apparent, however, that there are many millions of tons available for commercial use and the storehouse of nature is sufficient to supply all needs for Canadian and export business for an indefinite period.

In the lake beds there are a number of layers of salt, and below these there is a solid bed of the mineral, which is principally magnesium sulphate. Analysis of samples taken at various depths proved that arsenic, lead, iron, zinc, carbonate, phosphate and nitrate were completely absent, and traces only of chlorides and calcium were encountered. A large part of the surface deposits were proven to be quite up to U. S. P. and B. P. requirements. Magnesium sulphate has been taken from the surface area, which has tested 99.5 per cent. pure. In addition, the

magnesia waters from lakes one and two have been tested, and the properties of the water have been compared favorably with a number of other famous mineral waters from Indiana, Michigan and Austria-Hungary. When diluted to a proper extent it is established that the water from Lake No. 2 will make a good aperient mineral water.

Mining costs have been roughly estimated at about \$10 a ton, and this will probably be reduced considerably.

Commercial magnesium sulphate imported from Germany sold at approximately \$55 a ton before the war. It is felt that the Canadian product can compete with the imported mineral from any source.

Analysis of the Canadian product shows that it contains not less than 97.4 per cent. of pure magnesium sulphate, $\text{Mg SO}_4, 7 \text{ H}_2\text{O}$ (B.P.); also not less than 99.7 per cent. pure salt (U.S.P.); 0.5 grams of the sample yield 0.227 grams Mg P O (B.P.O. 220-0.226). It is free from arsenic, lead, iron and zinc, chlorides trace.

Glauber's Salts Also Produced.

An initial shipment of three cars of Glauber's salts was made from the Kitchener plant of the Salts & Potash Company of Canada, Ltd., this month. The Kitchener company is drawing its raw material from Lake Muskiki in Saskatchewan. It is proposed to enter the Canada market for both medicinal and industrial supplies of glauber salts.

Muskiki Lake is situated three miles north of Dana, Saskatchewan, close to the Prince Albert branch of the G. T. P. The lake is divided into three sections. The northern section, which is the largest, has an area of three and one-quarter square miles. The surface is covered with water to the depth of about twelve inches, and the bed of salt immediately under the water has an average depth of twelve inches. Underneath there is a bed of black slimy mud of from three to five feet, and a second layer of salt is located beneath the mud. It is estimated that there are 3,000,000 tons of sodium sulphate in the upper layer alone.

Necessity for Helium Conservation

By Andrew Stewart

BEFORE the outbreak of the World War, helium, first observed in 1868, as an element in the incandescent gases of the sun, was obtained only in very minute quantities as a scientific curiosity; but even so, enough was learned of its properties to demonstrate that on account of its perfect inertness, eliminating possibility of fire and explosion risk, and its extreme buoyancy, it would prove an ideal balloon gas if it could be produced in sufficiently large quantities. Then came its discovery, in 1907, in some of our Western natural gases, and the possibility for its utilization for balloon purposes began to take on form and substance, culminating in reality after the entry of the United States in the war.

It was recognized that the filling of military lighter-than-air craft with this non-inflammable gas would provide a weapon of such immense importance that it might prove one of the decisive factors in winning the war. The Navy and War Departments, therefore, took measures for the production of helium on a large scale. In co-operation with the Bureau of Mines and certain commercial concerns, plants for helium extraction were erected in Texas, and when the armistic was signed, about 150,000 cu. ft. of the gas, compressed under 2,000-pound pressure in steel cylinders, were ready on the dock for shipment to France.

But the supply of helium is apparently limited. Only a special type of natural gas contains it, and as this gas is being rapidly consumed for domestic and industrial purposes, the Government is putting

forth an effort to explore the extent of this resource and to provide ways and means to conserve it. A field survey is in progress, the aim of which is to locate gas wells suspected of containing helium, to analyze their contents, and to establish their probable ultimate yield.

Helium is found particularly in natural gases that do not burn readily—the so-called “wind gas”—because it is invariably accompanied by comparatively high percentages of nitrogen, a gas which is itself comparatively inert. Samples of such natural gas are taken from the wells and sent to the Bureau of Mines Experiment Station at Ft. Worth, Texas, where, in the laboratory, under the direction of Dr. C. W. Seibel, they are examined for helium. This laboratory would like to learn of the existence of such gas from any locality. In appropriate cases cylinders will be sent for collecting samples for analysis.

In Alberta and other parts of Canada there are, according to the “Monetary Times” (Canada), January 9, 1920, page 21, considerable helium resources, and the Canadian Government, realizing their extreme value, is taking steps to utilize them.

Herbert Sterling Wilson, chief chemist of the Collins Safety Razor Company, has devised a carbon determination apparatus, which is a new departure in this field. The usual loosely connected flasks are in this device replaced by two columns secured to each other in sections, by flanges held together by rubber bands. All parts are quickly attached and detached, and gas tight at the first trial, thereby overcoming difficulties by the old method. Any arrangement of chemicals may be used, and the construction is such that the current of gas may be either up or down.

Colloidal Fuel and Its Use

The Nature of Colloidal Fuel, Its Development During the War, Results by Trials, with a Review of Present and Future General Industrial Possibilities

By LINDON W. BATES *

COLLOIDAL FUEL is a combination of liquid hydro-carbon with pulverized carbonaceous substance, the components so combined and so treated as to form a stable fuel capable of being atomized and burned in a furnace. It is made in three forms, a liquid, a gel and a mobile paste. The new composite is intended primarily to be used as fuel. While the designation "Colloidal" is given it because so much of the combination is in the colloidal state, the name is not scientifically adequate, since much of the solid component is not reduced to colloidal dimensions. The title is, however, descriptive because of the important colloid-like characteristics of the composite. It is linked up to the ratios of oil sixty per cent. and coal forty per cent., or thereabouts. It is a mobile paste up to the ratio of oil twenty-five per cent. and coal seventy-five per cent. All kinds of oils and solid carbons may be used. The cheap coal breakages and wastes are all available. The liquid is used in the self-same way as oil fuel and with the same apparatus. The coal particles are maintained in a state of suspension in the oil during the time required for the use of the fuel—days, weeks or months.

In marine tests on the U. S. S. "Gem," equipped with Normand express boilers, colloidal fuel showed evaporative efficiency which reached 91.5% on a short run, while that of the Navy Oil did not on any run exceed 79.4%, and that of pulverized coal 72.6%. In general, colloidal fuel is on a parity with oil, while certain grades are superior. For example, on land boiler eight-hour tests made under certain return tubular boilers, colloidal fuel Grade 13 gave 76.8%, and Grade 14 gave 85.3% combined boiler and furnace efficiency from and at 212° F, both being compared with Mexican Reduced Oil, which on the same boilers gave 73.3% to 79.46%.

Colloidal fuel enjoys several special qualities. The calorific value per unit volume is greater than that of straight oil unless coals of very low heat value and specific gravity are incorporated. The reason is that coal is much heavier than oil, though of less calorific content, so that the coal content actually frequently raises the calorific value. The addition of coal is not an adulteration of the oil, but an enrichment. Thus in a composite made up of 35% by weight of pulverized anthracite coal of 14,000 B.T.U. per pound and 1.6 specific gravity and 65% oil of 18,200 B.T.U. per pound and .96 gravity, a gallon of the composite has 165,000 B.T.U., while oil has 146,000 B.T.U. per gallon.

Owing to its coal content, colloidal fuel is heavier than water, while oil is lighter, and the character of

the composite is such that it may be stored under a water seal and its fire may be quenched with water. The water forms a layer over the liquid combustible. The feature is of vast importance since an oil fire cannot be extinguished with water, and hence the rule governing its use are justifiably drastic. Not less than 6.4% of all fires are caused by "Fuel Oil," according to the National Fire Prevention Association.¹

The board of Standards and Appeals of New York City, of which Hon. John P. Leo is Chairman, adopted a set of rules which went into effect December 1st, 1919, to admit liquid fuel into the city. Rule 1 contains the following provision:

"The term 'oil for fuel purposes' under these rules includes any liquid or mobile mixture, substance or compound derived from or including petroleum."

The rule is phrased so as to admit colloidal fuel, which is a liquid or mobile mixture including petroleum. Colloidal fuel is also an exceptionally favorable situation under the Tentative Regulations of the National Fire Protection Association, adopted on November 3rd, 1919. These set the standard in Canada and in the United States. "Oil burning equipments are those using liquids having a flash point above 150 degrees F. closed cup tester." The word "liquids" was selected so as to include the new fuel. Section 1, Paragraph (a) provides: "For liquids of 20 degrees Baume and below, tanks may be of concrete," and section 4, Paragraph 34, states "Where it is necessary to heat oil in storage tanks in order to handle it, the oil shall not be heated to a temperature higher than 40 degrees F. below the flash point, closed cup." This excludes several varieties of fuel oils which require preheating over or close to their flash point in order to flow. This is not the case in the colloidal fuel. The Laboratory of the National Board of Fire Underwriters has certified that Grade 13 of the new fuel had a flash point of 266 degrees F. and Grade 15 had 273.20 degrees F. Grades 13 and 14 were preheated in practice to about 130 degrees F. The apparent ignition temperature was 779 degrees F. and 788 degrees F. respectively, while neither gave off volatiles at room temperature or 40 degrees C., nor gave evidence of spontaneous heating. It is for these reasons that colloidal fuel enjoys unusual safety features.

The combining of pulverized coal with oil and of tar with oil to make a liquid fuel has had devotees. As, however, oil does not ordinarily dissolve coal or

*Paper delivered before Ottawa Branch Canadian Section Society of Chemical Industry, Ottawa, December 12, 1919.

¹"Handbook of Fire Protection," Crosby-Fiske-Forster, 6th Edition, 1919, page 69.

tar, the problem was how to overcome the comparatively rapid and uncontrollable separation or settling out or sedimentation of some of the components. The present success was born immediately of the war efforts and was conceived to meet the shortage of fuel in the Allied navies. It is a highly scientific chemical development and its importance to industry cannot be overstated.

The superiority of atomizable over solid fuel has long been recognized and proven. The advantages are both in conservation and operation. Further, the cost and scarcity of refinable oils has set metes and bounds for their employment. Several causes have made desirable the evolution of a process for combining the cheaper or more plentiful sources of carbon with the liquid hydrocarbons. The former are generally solids such as coal and lignites or tars or pitches. The science of chemistry has at last in colloidal fuel disclosed an adequate creation. It gives a satisfactory, easy and cheap treatment, whereby gravitation is superseded in control and the desired fuel is secured. A new range or series of fuel has been developed each with the characteristics of its special "blend."

The chemistry of colloids is comparatively new, but a whole world there awaits development. Three states are now defined in the dispersion of combined substances, whether the composite be in the solid, gaseous or liquid form. These states are solution, colloid and suspension. While possessing each its distinctive qualities, they yet merge on the borderland into each other. Nature does not establish artificially limits for the states—the boundaries are man defined but are now generally accepted. The so-called "molecular" solutions, the colloids and the "coarse" or "mechanical" suspensions are of recognized delimitations. True solutions are those whose particles or droplets of the disperse phase in the medium are of a dimension less than $1\text{ }\mu\text{m}$ —i.e., have a diameter less than .000,000,1 c.m. In colloids the dispersed particles or droplets are between $.1\text{ }\mu\text{m}$ and $1\text{ }\mu\text{m}$ in diameter—that is, they are less than one hundred-thousandth, but greater than one ten-millionth centimeter in size. In suspensions the size (or diameter) of particles or droplets is larger than one hundred-thousandth of a centimeter, or $1\text{ }\mu\text{m}$. Emulsions and suspensions are to be differentiated. In emulsions the droplets are liquid and are above colloidal limits. They move in a liquid medium with which they do not mix. In suspensions solid particles also above colloidal limits move in a liquid medium. Emulsoids are emulsion components in a colloidal state while suspensoids are suspension components in a colloid state².

Between the suspension and the colloid states are certain definite distinctions. For instances, in a suspension, particles .001 c.m. in diameter just reveal Brownian movement. In a colloid the particles reveal rapid Brownian activity. Again, colloids can

be filtered through the finest filter paper without appreciable loss of particles. In a suspension the particles are held by the filter paper. Under the best microscopes magnifying 2,250 times, particles $15\text{ }\mu\text{m}$ in diameter become just visible. Larger particles may be measured. Smaller particles, those within colloidal limits, are not measurable and are barely detectable under an ultra microscope.

Solutions have a distinctive quality which is that in them dispersed particles do not settle to the bottom or rise to the top or under normal conditions separate. If the particles are sufficiently within the upper limits, the same will be a fact of the colloid state. As a natural characteristic, colloids have relative or nearly absolute stability, but of course by treatment the particles may in many cases be precipitated. This is true also of solutions. In suspensions, weight is an important element. It affects the deposit of particles as small as $50\text{ }\mu\text{m}$ or one-tenth of the length of a light wave. Hydrosols in which the particles are less than $20\text{ }\mu\text{m}$ in diameter remain clear and do not settle at all. Particles of $10\text{ }\mu\text{m}$ diameter and 3.0 specific gravity settle in water a distance of only 1 m.m. a month. For gold hydrosols, with particles $20\text{ }\mu\text{m}$ in size, the time of settling is calculated at 1 m.m. in seven hours.

In suspensions, weight and size of particles are important qualities. The tendency to precipitate to the bottom may be reversed for a movement of floating to the top. For instance, globules of caoutchouc from $.5\text{ }\mu\text{m}$ to $2.5\text{ }\mu\text{m}$ are found in Hevea latex, but in latex of Funtumia few particles have a diameter as great as $.1\text{ }\mu\text{m}$. Fat particles in milk are found through the wide range of from $.1\text{ }\mu\text{m}$ to $22.2\text{ }\mu\text{m}$. Zsigmondy³ reports that the study of coarse suspensions "reveals little save sedimentation." "Stability" and "suspension" as applied to the state of matter are not synonymous.

It has been stated that an atomizable fuel has very many advantages over one not atomizable. To secure this advantage, the components should be capable of simultaneous combustion. This necessitates mobility of the fuel and that its components shall be sufficiently stabilized to insure the fuel's passage through the pipes, preheater and other parts of the apparatus without congesting. Stability to this end manifestly may be variable in duration and degree. If the fuel is to be consumed at once after treatment, a short duration of stability may be adequate. If the fuel is to be stored, self evidently the stability must endure for the period of storage, be that days or months. The stability must also withstand certain changes in temperature, such as the preheat. To equip the composite with just the right stability is a fine art, calling for judgment and experience, since the particles must be kept from both precipitation and flotation for a determined interval. Sev-

²Burton, "The Physical Properties of Colloidal Solutions," 1916, page 10.

³Taylor, "The Chemistry of Colloids," 1916, pages 6, 18.

eral variable elements enter into the treatment and the character of the burning, conveying and atomizing systems must be also allowed for. In referring herein to "stability," adequate stability is claimed—stability sufficing as the case may be for quick use or for storage through months of time. This is a matter of regulation and control (within reasonable limits) of movements within the composite. To appreciate the extent and intent of this control of stability, how it is exercised and how obtained it is necessary to study the laws governing the motions of dispersed particles in a liquid medium.

Stokes' Law for the terminal velocity of a spherical body falling in a liquid gives a formula from which discussion may proceed. Under a constant force such as gravity the velocity is expressed by the equation

$$V = \frac{2r^2 (s-s') g}{9 \nu}$$

In this formula g is the constant of acceleration per unit mass, i.e., gravity; r is the radius of the sphere; s is the specific gravity of the sphere; s' that of the liquid; ν is absolute viscosity coefficient of the liquid. It is self-evident that the difference ($s-s'$) may be positive, zero or negative; the particle may fall or rise or remain stationary, depending upon whether its specific gravity be greater, less or just that of the liquid. The velocity whatever the direction, will be inversely proportional to the liquid's viscosity and proportional to the square of the radius⁴.

With the equation cited, having the equivalents for the several terms, one can figure for instance the theoretical rate of precipitation for pulverized coal in oil. Taking pulverized antl

It was because of the mortal issues swaying upon the command of the seas by the Allied Navies and their serious shortage of fuel that the writer renewed the search for a solution of this vital fuel problem. He undertook it in connection with an organization that should be passingly reviewed. Shortly after the United States entered the World War, about a hundred of the largest firms, American and foreign, engaged in shipping, oil, exporting, insurance and other world-wide business, combined to form the "Submarine Defense Association" to devise means for combatting submarines. Among the concerns acting were the Cunard Company, the Nippin Yusen Kaisha, the International Mercantile Marine, the Standard Oil Company of New Jersey, the Texas Company, the United Fruit Company, the Armour Grain Company and many others. Among the Canadian firms one may mention: The France and Canada Steamship Company, North British and Mercantile Insurance Company, James Richard-

son & Sons, Ltd., and The Royal Insurance Company. The offices were in New York City. The chairman was Mr. Lucius H. Beers, Counsel of the Cunard Company. Mr. John A. H. Hopkins was Vice-Chairman.

The writer was chosen Chairman of the Engineering Committee, the other members were Herbert Appleton, of Appleton & Cox; John R. Gordon, of the Union Sulphur Company; Ormsby M. Mitchell, of Power, Son & Company; Frederick W. Ridgway, of the International Mercantile Marine Company, and Ernest Smith, of the Vacuum Oil Company.

Several problems engaged the Association's efforts, and their work brought them into relations with the American, British and Japanese naval authorities, which most generously extended support and aid. Very early the shortage of the fuel supply for the fleet aroused the interest and the best endeavors of the Association. The vital units of the Allied navies had for some years relied chiefly upon oil for their motive power. Manifestly a right liquid fuel supply for the Grand Fleet was fundamental to sea control and to the winning of the war. The enemy centered efforts steadily upon cutting off the oil supply and the torpedoing of the tankers, with their inflammable contents and slow speed, was bringing a fateful shortage disastrously close. It was reported that Marshal Foch sent to the American authorities the following cable: "If you don't keep up your petroleum service, we shall lose the war."

In the face of the ominous situation, the British Admiralty sent to the writer drawings of the boiler installations of the Queen Elizabeth class of super-dreadnaughts, asking whether such vessels could to advantage burn pulverized coal. Admiral W. S. Benson, Chief of American Naval Operations, who had been most helpful in cooperating, placed at the disposal of the Association the U. S. S. "Gem," to be operated under the writer's direction for research work during the war. Upon receipt of the British drawings, a conference was held with the leading American pulverized coal companies, and it was arranged to try out on this vessel likely installation systems. Pulverized coal had been successfully used upon land, but naval experience was non-existent. The "Gem" was equipped with the highest class of Normand destroyer boilers, so the test could be conducted under right conditions and become authoritative. The demonstrations were clear that pulverized coal could be burned on ship-board and keep up steam. Since, however, pulverized coal required for storage nearly twice the volume needed for oil producing equal heat units, it was self-evident that the use of coal would cut down the steaming radius. As a ship's supreme service would be therefore lessened, for strategic reasons on battleships of the Grand Fleet, the use of pulverized coal could not be advised.

⁴"The Chemistry of Colloids," 1917, page, 22.

⁵Hatschek, "Introduction to the Physics and Chemistry of Colloids," 1916, pages 23, 24.

Appreciating that despite all the advantages that were unquestionable in the service of pulverized coal for certain uses, it would not work out an adequate solution for this imminent naval fuel shortage, the writer turned again to the elusive but ever-alluring hope of a right means of combining coal and oil. This must conserve the oil without lessening the steaming radius and efficiency of the warships, since steaming radius was the very crux of their service. As far back as the eighties, or nearly forty years ago, he had taken up the study of this problem in conjunction with some other developments of a chemical nature. Incidentally to the latter process, he became convinced that the solution, if ever found, would lay along certain lines which he proceeded to develop. At his instance, through the courtesy of Mr. George Eastman and Dr. C. E. K. Mees, the facilities of the Kodak Research Laboratory at Rochester were opened to him in 1917 to try out the ideas and convictions which he expressed. Expert chemists, including Dr. S. E. Shepperd, Mr. J. G. Capstaff and Mr. L. Ebelin, were delegated to assist in the investigation of the laboratory aspects of the subject. As a result of many months careful study under his direction, it was verified that a composite could be made along the lines indicated. Numerous laboratory tests were made at Rochester. Later a supply of the composite was made elsewhere for marine service tests under the auspices

of the Submarine Defense Association. From April to July, 1918, a series of tests were made aboard the U. S. S. "Gem," which were exceedingly successful. It was proved that the product created measured up to the requirements of industry, as well as to those of the laboratory. The vital transition and adjustment of a process from this essential yet preliminary and necessarily partial laboratory stage to that of practical industrial service was passed with success. The tests and demonstrations were witnessed during these months by officials of the United States and Allied Governments and Navies, and by representatives of many boards and business groups. About three hundred delegated investigators witnessed the operations aboard the U. S. S. "Gem."

In November, 1918, suddenly, the armistice brought the war to an end, and the naval crisis passed with it. The various bodies which had banded in volunteer efforts, for the myriad needs of the allied countries, felt that their tasks were done. Men were free again to turn to normal life and begin the vast task of reconstructing and revitalizing in the service of peace. As industrial fabric had been so seriously dislocated by the war, attention was turned from the crucial maritime emergency for which colloidal fuel had been devised to adapting it next for use in the myriad phases of economic industry.

(To Be Continued)

Oil Companies Formed Fewer in Number

DURING the month of February sixteen companies with an authorized capital of \$50,000 or over were organized in the United States for the production or distribution of drugs, chemicals and dyes. Their aggregate authorized capital amounted to \$12,585,000. Both the number of companies organized and their aggregate capital was smaller than it was in the preceding month. This decrease is held to be due to the uncertainty which still exists in regard to the degree of protection which is to be given the chemical industries by the tariff.

The following tabulation, vouched for by the Journal of Commerce, New York City, gives the authorized capital of the chemical drug and dye companies incorporated during the periods indicated:

Year 1915.....	\$65,565,000
Year 1916.....	99,244,000
Year 1917.....	146,160,000
Year 1918.....	73,403,000
1919.....	
January.....	2,680,000
February.....	15,680,000
March.....	5,115,000
April.....	7,040,000
May.....	3,575,000
June.....	17,356,000
July.....	11,550,000
August.....	8,350,000

September.....	6,100,000
October.....	7,883,000
November.....	6,690,000
December.....	20,145,000
Total.....	\$112,173,000
1920.....	
January.....	17,943,000
February.....	12,585,000

There have been rumors of a possible understanding between the German and the French potash interests respecting the control of sales and prices. In this connection M. Paul-Albert Helmer, the head of the sequestration office of the Alsatian potash mines, is quoted in the journal "L'Information" as opposing strongly such an understanding, which would re-establish the pre-war potash monopoly and would tend particularly to benefit Germany at the expense of France and other countries. The Germans are said to be eager to enter into such an agreement. M. Helmer is also quoted as saying that one of the terms imposed by England as a condition to the supply of Alsatian potash to that country is that no agreement be entered into between French and German potash interests which would be detrimental to England.

The A B C of the Modern Atomic Theory

Dr. Irving Langmuir, Recipient of the William H. Nichols Medal for 1919, Explains in Everyday Terms, the Complexities of the Modern Theory Regarding the Structure of Matter.

COMPARING the atom to a baseball which forms a part of the great World Series, Dr. Irving Langmuir, March 5, gave a modern exposition of the atomic theory before the New York Section of the American Chemical Society at Rumford Hall, 50 East Forty-first street, New York.

His address was given in acceptance of the William H. Nichols medal awarded to him for the most original paper printed in the year 1919 in the publications of the American Chemical Society. His theme was "The Arrangement of Electrons in Atoms and Molecules."

Dr. Langmuir, one of the best known physical chemists in the United States, has had a most practical experience with the atoms and molecules and the forces which bind them together, for he is a research expert connected with the General Electric Company.

"According to our present views," said Dr. Langmuir, "all forms of matter are built up of atoms, but we no longer regard these atoms as indivisible, nor even as simple structures. If a lump of ordinary matter the size of a baseball could be magnified to the size of the earth, the atoms in it would then have become about the size of baseballs. In other words, an atom is about as big compared to a baseball as the baseball is when compared to the earth. The atoms are constructed of particles of positive and negative electricity arranged in a very open structure. All the positive electricity is concentrated into a very small particle, called the nucleus, located at the center of the atom. The negative electricity exists in the form of electrons which arrange themselves in space about the nucleus. The size of the electron and nucleus is small compared with that of the atom itself. Thus if we imagine an atom magnified until it has a diameter of one mile, the electrons would be about five feet in diameter, while the nucleus at the center would be only the size of a walnut.

"The electrons in different kinds of atoms are alike, but there are so many different kinds of nuclei as there are chemical elements—that is, about ninety-two in all. These differ from one another only in the amount of positive electricity they contain. Thus for the simplest element, hydrogen, the nucleus has a unit positive charge which is able to neutralize the charge of a single electron. A hydrogen atom then consists merely of the nucleus and a single electron. The next element, helium, has a nucleus with a double positive charge and the atom thus contains two electrons. In a similar way we find that the atoms of carbon have six

electrons, while oxygen has eight, aluminum thirteen, sulphur sixteen, iron twenty-six, copper twenty-nine, silver forty-seven, gold seventy-nine, lead eighty-two, and radium eight-eight electrons.

"These electrons do not revolve around the nucleus the way the earth revolves around the sun, but they are arranged in three dimensions in a series of layers or concentric shells surrounding the nucleus. The electrons are probably not stationary, but each revolves in its own orbit about a certain equilibrium position. However, as we do not yet know much about these orbits, we can speak of the positions of the electrons in the atoms as though the electrons were located in these equilibrium positions.

"The first two electrons in any atom form the first shell about the nucleus—that is, two electrons are much closer to the nucleus than any of the others. In atoms with more electrons the next eight electrons form the second layer; then comes another layer of eight. If there are still more electrons these arrange themselves in a layer of eighteen, followed by a second layer of eighteen, and finally there may be an outside layer of thirty-two electrons. It is the successive formation of these various layers which causes the similar or recurring properties among the chemical elements which underlie the Periodic Table of the elements that is of such fundamental importance in chemistry.

"The eight electrons in the second and third layers are arranged in a symmetrical way like the arrangement of the eight corners of a cube. This stable group of eight electrons is called the Octet. The chemical properties of the elements result from the tendency of the individual atoms to take up or give up electrons in order to form these octets. That is, the atoms strive to take certain stable configurations characterized by geometrical symmetry. They accomplish this in some cases by exchanging electrons with each other, while in other cases the atoms share pairs of electrons with each other—a sort of co-operative plan. The pairs of electrons thus constitute the chemical bonds between atoms which play such a prominent part in chemistry.

"This theory of atomic structure and chemical combination not only explains an enormous number of chemical laws which have been obtained by experiment, but it leads to important extensions and in some cases to modifications of these laws, while in other cases it has led to new relationships and has made it possible to predict correctly the properties of certain substances before these properties have been determined by experiment."

Sibert Transfer Punishment, Says Herty

GENERAL SIBERT, like General Wood, has paid the price," said Dr. Charles H. Herty, editor of the *Journal of Industrial and Engineering Chemistry*, in an address on Tuesday, March 2, before the members of the Western New York Section of the American Chemical Society at Buffalo. The reference was to the order of the War Department just issued transferring Major General W. L. Sibert from his present position as head of the Chemical Warfare Service to the command of Camp Gordon, near Atlanta, Georgia.

"Long before we entered the war," continued Dr. Herty, "General Wood persistently advocated the immediate and thorough preparation of the nation for the great struggle into which we were steadily drifting. His words found a ready response among many of our people, but not with the high officials of the War Department. Still he persevered in his appeal, and gradually the force of circumstances thoroughly justified his position. But when the day of struggle came, to the surprise of all, General Wood was relegated to a camp command, and thereby prevented from participating in the field operations of the war. He paid the penalty for having advocated that which was not in harmony with the views of those having the power to effect such preparedness.

"The developments of the war proved clearly that one of the great features of future conflicts was to be chemical warfare, and again an appeal has been made—this time through General Sibert and for the new form of preparedness, gas warfare. But in urging this vital need, General Sibert has had to run counter to the same elements that sought to block the way for General Wood.

"High authorities of the War Department, including the Secretary of War and the Chief of Staff, have sought to minimize the need for such preparedness by insisting that the Chemical Warfare Service should be made a minor division of the Engineering Corps or the Ordnance Division. General Sibert has had the strong backing of the chemists of the country in his position. Called upon by committees of both the House and the Senate, he put himself squarely on record that every encouragement should be given to a development of the Chemical Warfare Service,

which could not be hoped for under the plan advocated by the Secretary of War and Chief of Staff. General Sibert insisted that the Chemical Warfare Service should be made a separate unit in the reorganized army which is now being provided for in Congress. His arguments were so convincing that the committees of both the Senate and the House have voted favorably upon his recommendation.

"The present order removing General Sibert from the direction of the Chemical Warfare Service evidently is a slap in the face for his temerity in expressing views differing from those of his superiors.

"It is possible that there may be an added motive in seeking, as before, to minimize the importance of the Chemical Warfare Service and to leave as its head not a Major-General but a Lieutenant-Colonel. This would be in line with the past attitude of the Secretary of War and Chief of Staff, but fortunately the final decision of the matter lies in the hands of Congress—and it is very clear from the action of the committees that Congress is likely to settle this matter right.

"General Sibert proved himself a master of organization in bringing together the various scattered efforts in government circles to develop chemical warfare, and made that service the most powerful in the world. By his magnetic personality he drew the earnest support of all civilian chemists.

"When Congress approved the appointment of General Sibert as Major-General in recognition of his splendid work in the construction of the Panama Canal, he received the privilege of retiring whenever he desired. His usefulness to the nation since that time has been doubled by his effective work as the ranking officer of the Chemical Warfare Service, and it is an unfortunate commentary upon War Department policies that just at the time when he had won Congress to his views, he should be told to 'step to the rear.'

"It is peculiarly appropriate that this protest should be lodged in that city where the greatest of all of our dye manufacturing plants has been developed, and in which, therefore, the Chemical Warfare Service will find one of its strongest reserves and its ablest supporters."

American University Training Not Practical

A LITTLE controversy has been raging in the pages of the *Yale News*, a students' publication of the university of the same name, regarding the methods and usefulness of the American university. To this controversy, if it may be so called, two men of some prominence in the world today have made contributions, one John Hays

Hammond and the other J. Ogden Armour. This is what Mr. Hammond had to say:

"The American university is out of touch and contact with the world because its officers and professors are out of contact, and however much they may profess to know about the ways of the world they will not be able to impress the undergrad-

uates unless they have demonstrated their knowledge by a record of achievement.

"Therefore, I should put a man who has made his mark at the head of an institution rather than a scholar.

"Today ambition, thoroughness and earnestness are in degree bad form among undergraduates, and the fellow who's avowedly or even professedly at college with the primary object of equipping himself for a career is in the way of being an amusing character.

"Most young men do not view their university days very seriously. They frequently give more attention to the useless trimmings—to the expensive societies, to a show of wealth and to general loose living and heedless extravagance than to their studies, and they will continue to do so until they can have set before them a new ideal in the way of a man who will tear down the false insignia of manhood.

"I am sharply in disagreement with the way that our educational institutions are conducted and with the results they achieve. They are doing only a fraction of the work they should do and they are turning out a quite undue proportion of boys with no higher ambition than to 'tout' for some stock-

broker's office and thus to live off the losses of their acquaintances.

"We are wasting a lot of valuable time in our colleges. They are not serving the nation as they might, and I am afraid that the large endowments which are now being accumulated will, unless care from the outside is used, tend to confirm the present practice instead of broadening the institutions for their present real tasks. For the ills are deep-seated. Too great a part of the bequests are expended in brick and mortar, rather than in the essential apparatus for instruction.

"It is very nice to have a young graduate thoroughly convinced that the institution he has attended is the best of its kind. We all of us get a great deal of fun out of this chaff, but unfortunately it shows that we are foggy about why we send boys to a university.

"I do not say that a college education is useless, but the boys have too much to learn about things that they should know and too much to forget about things they did not need to know in the first place. They have spent too much time on subjects which they will not use and too little on some of the subjects that they will most desperately need, instead of doing something useful."

American Chemical Engineers to Visit Canada in June

THE summer meeting of the American Institute of Chemical Engineers will be held in Canada. The date has been fixed tentatively as June 21-26. Plans as worked out at present include a meeting of two days, Monday and Tuesday, at Montreal, for the business sessions, reading of papers and possibly one or two excursions to chemical industries in Montreal.

The program of papers to be presented is being prepared and the secretary desires information as to papers being prepared for presentation at this meeting. Members are urged to present to the Society as many papers as possible in order to make the meeting profitable and the *transactions* valuable. A special endeavor is being made to secure papers on electrolytic industries, and papers on this subject are especially desired.

Wednesday will be spent at Ottawa visiting the copper and nickel refinery of the British-American Nickel Corporation, also inspection of the Government buildings and the laboratories of the Bureau of Mines.

Thursday and Friday will be spent at Shawinigan Falls seeing the power development and the electrolytic industries located in this vicinity.

Saturday will be spent at LaTuque where permission has been secured from the Brown Company

for a visit to the very large sulphate pulp mill where the explosion process described by Hugh K. Moore at our Savannah meeting is in operation. From this point a trip is being planned to the large artificial lake which has been made at La Loutre. This includes a 50-mile boat trip, stopping at a fishing camp on the lake where there will be opportunity for motor boating and fishing. After a stop of a day or two in this very picturesque and wild part of Canada, the return trip will be made to Quebec.

Arrangements have been made with the Canadian National Railways for a special train for making the trip from Montreal to Ottawa, to Shawinigan Falls, LaTuque, La Loutre and return to Quebec. The train will consist of a sufficient number of pullmans, with a dining car for meals. This will provide sleeping accommodations during the trip, as hotel accommodations cannot be obtained outside of Montreal and Ottawa.

Thomas J. Keenan, secretary of the Technical Association of the Pulp and Paper Industry, has sent out a call to members for the annual meeting to be held at the Waldorf-Astoria, April 13-15. The first day's programme calls for meetings of the standing committees, the general meeting of the association to begin the following morning. At this session a number of technical and scientific papers will be presented for discussion. The annual dinner will be held in the evening.

A French Opinion of the German Menace

German Commercial Houses Still Practice the Methods of Getting Business They Used Before the War. Their Successful Efforts of Even the Last Few Months Hold a Warning for Allied Business Men.

Translator's Note—The following article by Camille Matignon in "Chimie et Industrie, Jan. 1920," indicates that the Teuton has lost none of his business enterprise by reason of military defeat, and is likely to prove within a short time as formidable a competitor as ever.

IN an English book entitled "Made in Germany," which appeared, if my recollection is correct, about 1900, and was reviewed in some detail in the *Revue des Deux Mondes*, the author set forth the progress already made by German industry, predicted its growth and development, and in seeking the causes of this progress, laid bare with some exactness the methods followed by the German merchants and manufacturers in conquering the world market and steadily extending the field of their activity.

We all know how promptly the German firms answered an inquiry; how readily they furnished to a possible client, no matter how remote the chances of doing business with him, complete plans of apparatus carefully designed to do the work in question.

A few years before the war a syndicate was formed to build in the Yonne district a cement plant of the ordinary rotary kiln type. The surrounding country carried plenty of shale which by proper mixing and treatment should have constituted an excellent raw material; indeed, it was already being used in a small plant there. The obvious thing to do, then, was to undertake a systematic study of these deposits, and with the results of this study as a basis to make some large scale runs in an effort to produce cement of the highest quality.

In the course of making up an estimate of the probable cost of the whole plant, the syndicate addressed an inquiry to a German firm regarding the price of the kilns. The firm in question at once sent an engineer to France with instructions to put himself entirely at the disposal of the French syndicate, to advise them upon their project, and to furnish them with complete plans and drawings. The preliminary chemical work referred to had not yet been done, so the engineer carried away samples of the deposits for analysis and for small scale cement tests. In this way, with the sole object of obtaining an order for some rotary kilns, the German house lent its whole-hearted collaboration to the scheme, an assistance which was the more valuable on account of the long experience of the firm in designing just this kind of plant. For certain reasons the project was abandoned, although the preliminary tests, since verified, gave excellent promise.

This example illustrates in a striking way the *modus operandi* of the Germans which was the

more effective because their competitors in other countries failed to adopt similar tactics.

Has the war really brought about any change in the mental processes of the commercial men of the allied countries? Will they really make the effort necessary to obtain and to hold new clients? The following incident seems to indicate not. It was related by an interested person, an Italian scientist who was forced by the war to turn his attention from researches in theoretical physics to certain industrial problems vital to the economic development of his country. This man has just introduced into Italy a new industry which bids fair, if all goes well, as seems likely, to have a brilliant future.

It was necessary, in the first place, to erect a factory to contain certain grinding and crushing machinery, the latter constituting the most important feature of the plant. The narrator made application to certain manufacturers in the allied countries, who specialized in such machinery, for information and for prices. Samples of the rock to be ground were sent to two English, two French and two American firms, and quotations were asked on the necessary machinery; also, for the sake of comparison, an inquiry was directed to Krupp's, who, of course, have maintained for some time a department for the building of such apparatus. All this was in the middle of 1919. The French firms merely sent their catalogues, one English and one American company went to the trouble of stating their current prices. What was the amazement of the Italian, however, when scarcely a week from the day the inquiry was despatched a Krupp engineer stepped off the train at Rome, secured a goodly sample of the proposed raw material and offered to supply within a very short time complete plans of a grinding plant with a guaranteed output depending upon the horsepower to be employed.

To draw a sweeping conclusion from one particular case is, of course, a gross error in logic; still more absurd would it be, however, to ignore entirely such vital differences in the mode of conducting business shown by the German firms and their allied competitors. We must force ourselves to see if our methods remain unchanged, reorganized Germany will not fall far short of reconquering her old commercial supremacy.

The Tariff Commission has issued a report on "The Acids of Paragraph I and Related Materials provided for in the Tariff Act of 1913." The report presents a general economic survey of the industries producing citric, oxalic, formic, lactic, gallic, boric and tartaric acids. Copies of this report may be obtained on application to the commission.

Chemists To Discuss Patent Laws

Program of the St. Louis Meeting of the American Chemical Society Will Contain Series of Interesting Symposia and Addresses. Status of Dye Section of Society to Be Discussed.

Many Plants to Be Inspected.

CONFISCATION of German-owned American patents and the present American patent laws will come up for discussion at the meeting of the American Chemical Society to be held in St. Louis beginning April 14. A proposal to raise the newly created dye section to the rank of a division will also be voted upon, owing to the rapid increase in its membership, despite the obstacles which the dye industry has encountered. Speakers scheduled at the meeting will include Herbert Hoover, Dr. Tausig, late chairman of the Tariff Commission and Dr. Charles H. Herty, editor of the "Journal of Industrial and Engineering Chemistry."

In a statement regarding the status of the dye industry, R. Norris Shreve, secretary of the dye section, criticizes the delay in legislative action which involves the continuance of uncertainties in the trade.

"How essential an adjustment of the conditions governing the importation of dyes is to the United States," said Mr. Shreve, "is shown by the wide interest which this question has elicited in all branches of industry. The American Chemical Society, with its membership of fourteen thousand, is in contact with every class of manufacturing in this country and naturally we should feel the reflex of these unsettled conditions. The American chemist is well able to make dyes equal to those produced anywhere else in the world; but the color industry cannot be put on a permanent basis without the investment of millions of dollars."

4.00 P. M.—Council meeting.

Monday, April 12.

7.30 P. M.—Council dinner at the University Club.

Tuesday, April 13.

10.00 A. M.—General meeting, Hotel Statler. Address of welcome, Hon. Henry W. Kiel, Mayor of St. Louis; Response, Dr. W. A. Noyes, President, American Chemical Society; Address, Hon. E. P. Costigan, Tariff Commissioner, "Chemical Industry and Legislation"; Address, Dr. Chas. H. Herty, Editor, "Victory and Its Responsibility."

2.00 P. M.—Hotel Statler, general meeting. J. H. Hildebrand, "The Prediction of Solubility"; Victor Lenher, "Selenium Oxychloride a Neglected Inorganic Solvent"; E. T. Wherry, "Studying Plant Distribution with Hydrogen Ion Indicators." Three additional general papers to be announced.

8.00 P. M.—Missouri Athletic Association. Smoker for men.

8.00 P. M.—Theatre party for ladies.

Wednesday, April 14.

9.00 A. M.—Hotel Statler, divisional meetings.

2.00 P. M.—Excursions to Laclede Gas Works, Monsanto Chemical Works, East St. Louis plant, and Laclede-Christy Clay Products plant. Automobile tour for ladies to parks, Art Museum, Washington University, Missouri Botanical Garden, and tea at Bevo Mill.

8.00 P. M.—Central High School. Public address. Speaker and subject will appear in final program.

Thursday, April 15.

9.00 A. M.—Hotel Statler, divisional meetings.

2.00 P. M.—Hotel Statler, divisional meetings.

8.00 P. M.—Hotel Statler, subscription banquet.

Friday, April 16.

9.00 A. M.—Excursion to Standard Oil Refinery, Wood River, Ill., and Illinois Glass Company, Alton, Ill.

A theatre party Tuesday evening, and an automobile tour and tea party, Wednesday afternoon, are planned for the ladies.

The usual meeting will be held by all of the divisions except the Fertilizer Division.

The Division of Industrial and Engineering Chemistry will hold a symposium on Cellulose Chemistry, this symposium having been organized by Mr. Jasper E. Crane, and will devote the remainder of its program to general papers. It is hoped that an unusually large percentage of these papers will be upon engineering subjects, as that feature of the work is seldom emphasized as it should be. The division again calls attention to its requirement that authors must submit brief abstracts of their papers or discussions with the titles submitted, as otherwise they can not be placed upon the program. Communications with reference to the meeting, abstracts and titles should be sent to the Secretary, Harrison L. Howe, at 1201 Sixteenth Street, NW., Washington, D. C.

The Secretary of the Dye Section invites correspondence with scientific workers in the field of dyes and intermediates, with the aim of presenting the results of their work before the Dye Section. Communications should be addressed to R. Norris Shreve, Secretary, Dye Section, 43 Fifth Avenue, New York, N. Y.

A section of Leather Chemistry has been authorized for the St. Louis meeting. It is the purpose to establish a forum for the discussion of the chemistry of leather manufacture and other closely allied industries. All those interested in leather manufacture are invited to enroll as members of this section, to attend its session in St. Louis, and if a paper is to be presented, to submit its title and an abstract of same to William Klaber, Secretary, Leather Chemistry Section, 613 North Third Street, Newark, N. J.

A Section of Sugar Chemistry will also meet for the first time in St. Louis, under the chairmanship of C. A. Brown, with Frederick J. Bates of the Bureau of Standards as Secretary. A number of important papers have already been promised. There will be exhibited at the meeting the newly American-made saccharimeter. It is possible that this section may hold a joint meeting with the Division of Agricultural and Food Chemistry. See the final program.

The Division of Physical and Inorganic Chemistry will give a half day to a "Colloid Symposium." About six papers with plenty of discussion will be given by invitation and more time allowed than on the rest of the program. Also topics of general interest to colloid men will be brought up. All other colloid papers offered will be put on the regular Physical and Inorganic Division program.

The following are already promised: Col. W. D. Bancroft, on "Gelatinous Precipitates." Albert V. Bleining, on "Clays and Ceramics." Marton H. Fischer, on "The Solvation of Soaps." John Arthur Wilson, on "Vegetable Tanning as a Colloid Chemical Process," and two more will be added.

All titles for papers must be in the Secretary's hands on or before March 29, or in the hands of the Secretaries of divisions on or before March 26.

The Division of Industrial and Chemical Engineers has a rule that abstracts of papers to be presented in its program must accompany titles, if these titles are to appear in the final program, and,

further, the time limit for the presentation shall be five minutes, unless special arrangements are made with the secretary of the division.

By vote of the Council no papers may be presented at the meeting, titles for which are not printed on the final program.

"By Title" should be placed on the announcement of any paper where the author is to be absent, so that members may understand in advance that the paper will not be read.

The following are the addresses of the divisional and sectional secretaries.

Divisions.

Agricultural and Food Chemistry: T. J. Bryan, 4100 Filmore St., Chicago, Ill.

Biological Chemistry: Arthur H. Dox, Iowa State College, Ames, Iowa.

Fertilizer Chemistry: H. C. Moore, Armour Fertilizer Works, Atlanta, Ga. (Will not meet.)

Industrial and Engineering Chemistry: H. E. Howe, 1201 Sixteenth St., Washington, D. C.

Organic Chemistry: Roger Adams, University of Illinois, Urbana, Ill.

Pharmaceutical Chemistry: Edgar B. Carter, 2615 Ashland Ave., Indianapolis, Ind.

Physical and Inorganic Chemistry: H. N. Holmes, Severance Chemical Laboratories, Oberlin, Ohio.

Rubber Chemistry: A. H. Smith, Goodyear Tire & Rubber Co., Akron, Ohio.

Water, Sewage, and Sanitation Chemistry: W. W. Skinner, Bureau of Chemistry, Washington, D. C.

Sections.

Dye Chemistry: R. Norris Shreve, 43 Fifth Ave., New York City.

Leather Chemistry: William Klaber, 613 N. Third St., Newark, N. J.

Sugar Chemistry: Frederick J. Bates, Bureau of Standards, Washington, D. C.

Mr. H. S. Sidebottom, Secretary of the New York Section, 17 Battery Place, New York City, is arranging for a special car to go over the Pennsylvania Railroad from New York to St. Louis, via Philadelphia and Pittsburgh. Members in these cities or any member who can use this car to advantage should communicate direct with Mr. Sidebottom.

British Chemical Prices On Up Grade

ACCORDING to recent reports from Great Britain chemical and dye prices are rising. A writer in the trade supplement of the "Times" has the following to say regarding the English situation:

"Heavy chemicals continue to be a strong market, and prices show a distinctly upward tendency in the face of short supplies. The difficulties of manufacturing, mainly connected with fuel and the difficulty of transport of raw material, are increasing.

"Comparatively cheap American parcels are no longer on the market in face of the course of exchange, but it is a significant fact that the United States Alkali Export Association is considering a bid from an English firm for 6,000 tons of caustic soda.

This is destined for the European market, and larger quantities may be tendered for. There is some criticism in the United States of the Alkali Association supplying this market through an English company, but the soda will probably be released as a step in the general agreement as to sharing the world's markets.

"A report will shortly be issued by the representative committee which went to Germany to purchase dyes and study conditions.

"The controversy as to the nature of the protection to be afforded to the British synthetic chemical industry, revived by the resolution of the Manchester Chamber of Commerce recommending a subsidy, has

led to many suggestions from textile circles. Some dyers support the Manchester resolutions, others suggest that there should be a tariff on imported dyes and that the product of this tariff should be divided among British manufacturers of intermediates. The value of this suggestion is that, apart from the importance of encouraging the manufacture of intermediates in this country, the plant used for the purpose is always convertible to the production of explosives. A member of the committee appointed to purchase dyes from Germany believes that of the three proposed measures for safeguarding the industry—a State subsidy, imports under license or a protective tariff—the committee prefers a subsidy or the license system. The same difficulty of agreement as to the exact nature of the methods of safeguarding the industry is experienced in America.

"Irvine Keene, of the American Chamber of Commerce, has replied to his critics. The believers in the story of huge German stocks of dyestuffs have claimed that at the date of the armistice Germany had 450,000 tons of finished dyes in hand, and that they had still been producing at the rate of 1,000 tons weekly. Mr. Keene states that he visited all the plants with the exception of the Badische, after first calling at the licensing bureau in Berlin and obtained an unqualified permission to purchase what he could. But he found little merchandise to purchase. His own opinion is that considering that the German color makers are eager to obtain money for raw materials, the cause of his ill success was the lack of goods to offer. Meanwhile, returns just published by the United States Department of Commerce show that in the eleven months ended December 1 America imported 141,453 pounds of German dyes valued at \$82,643. It is probable, however, that the bulk of these dyes had been lying in Holland during the war, awaiting delivery against orders placed before the outbreak of hostilities."

London Market Dull

There is a dull time in the oil stock market just now, the "Financial News" of London, England, records, and a sorry time ahead for doubtful concerns if the condition continues, it says. In this respect it points out that the United Kingdom is not nearly so dependent upon the United States for its motor spirit supplies as it was in the war period, when practically the whole of our requirements were met (at least for many months) by America.

During January of this year of the 9,500,000 gallons of motor spirit which came to this country, considerably under one-third of this quantity came from America. The "Shell" interests in the Far East supplied over 4,500,000 gallons, and the remainder—about 2,000,000 gallons—came from the Mexican fields. This fact alone shows that this country can now draw the largest part of its requirements from fields outside the United States, and the same

remark, of course, holds good in regard to other centers of consumption.

Very slow progress is being made with regard to the resuscitation of Rumania's export oil trade, the consequence being that oilfield operations are for the most part being seriously curtailed. The production of crude oil is about 90,000 tons per month, and though this figure could without great difficulty be materially increased, it is inadvisable to do so until the present congestion at the refineries in connection with the storage facilities is relieved. The only manner in which this can be accomplished successfully is for the export trade to be considerably increased. The available refinery storage is limited to about 250,000 tons of oil products, and there is almost this quantity now in store awaiting removal. It may not be generally known that a feeling has group up in Rumania that the country ought to have the control of the oil industry in its own hands, and that foreigners should only be allowed to come into participation of it if this were deemed necessary. The Ministry of Industry and Commerce holds the view that it would be a wrong policy to exclude foreign capital or to seriously impede its advent, since the Rumanian petroleum industry in the pre-war days grew strong simply as a result of the influx of foreign capital. Bratiano's Government suppressed by a decree the liberty of oil land transactions, but it is expected that this will be soon changed. Meanwhile, it is interesting to learn that several influential English oil capitalists are seeking to secure oil lands and refinery propositions in Rumania, and already one or two have closed important deals, the results of which will be that in the next few months we shall see the public flotation of one or more Rumanian companies on the English market.

The Mexican Oil Supply

The fact that the United States is importing very large quantities of Mexican oil for refining purposes at its various Atlantic coastal points suggests that even should a serious shortage occur in the States crude oil output, this can without difficulty be met from the Mexican fields. Now that a temporary agreement has been made between President Carranza and the oil-operating companies in the country, it is expected that henceforth Mexico will experience almost unprecedented oil activity.

The Wheeler Condenser & Engineering Co., Carteret, N. J., announce the publication of the 1920 edition of their popular "Steam Tables for Condenser Work." This is the fifth edition. The pressures below atmosphere have been especially calculated for this book by Prof. Marks. The book gives the properties of saturated steam from 29.8 in. vacuum to atmospheric pressure in increments of tenths of an inch. The vacuum in inches of mercury is referred to a 30-in. barometer. This method is, of course, superior to the old method of giving absolute pressures in pounds per square inch, since it is customary to read vacuum in inches of mercury. A complete table is also given of the properties of saturated steam above atmospheric pressure. Copies will be sent on request.

Governors of Proposed Laboratory Resign

In Letter to Delegates Who Elected Them, They Claim That the National Laboratory Foundation's Connection with Other Organizations Militates Against Its Success

THE movement started early in January at a meeting held in the Hotel Astor, New York City, to raise funds to endow a national laboratory, for the development of American inventions, has met a setback, through the resignation of the Board of Governors, appointed at that meeting. The members of the Board have resigned in a body and sent the following letter to those who attended the meeting at the Astor:

"We, the undersigned, were, on January 9, 1920, elected to serve as Governors of the proposed National Laboratory Foundation, and have tried to carry out the high recommendations and aims of the convention because we believe their realization to be a national need.

"But we discovered connections with other organizations of such a nature as would, in our opinion, prevent this attempted organization from ever being successful. After spending two months' effort and over two thousand dollars of our own money trying to clear the situation and seeing no way of doing so with certainty, we refuse to be further connected with, or to be the cause of others joining, this National Laboratory Foundation, and we feel obliged to send this report and the following resolutions to each of the delegates who elected us and to resign.

"Twenty men were nominated for this board. Two refused to serve; one failed to accept.

"In view of the foregoing the Board of Governors at a meeting called on due notice, and held on the twelfth day of March, 1920, at which the undersigned eleven members, being a majority of the board, were present in person, unanimously adopted the following resolutions:

"Whereas, in our opinion, the convention of January ninth, at the Astor Hotel, was conducted toward ends contrary to those agreed upon in planning it, and contrary, it is believed, to the desire of most of the delegates there present who elected us, and has become so entangled with the National Institute of Inventors and the National Inventors' Sales Corporation and their personnel, policies and methods as to insure the defeat of the purposes of the delegation.

"Now, therefore, be it resolved, that we, the members of the board as individuals, cannot conscientiously urge any one in any way to support this present movement for an incorporated National Laboratory Foundation.

"That, in the opinion of the board, the purposes of the proposed incorporation having been rendered impossible of achievement with the present organization, the board deems it proper to decline to accept any donations now in the custody of W. M. Grosvenor, or which may hereafter be received, and

that W. M. Grosvenor be, and hereby is, instructed to return said donations to the donors and all pledge cards and pledges to the makers with the thanks of the board and a copy of this resolution.

"Be it further resolved, that we, as a board, deem it inadvisable in the interest of the delegates to the convention to attempt the development of a clean, strong foundation on the uncertain ground laid out at the convention, and herewith accept the resignations of the absent members of the board—to wit: Lee de Forest, Howard Elliott, L. S. Gardner, A. Simonds and L. A. Subers—for the best interests of these members themselves, as well as the best interests of the movement we believe, the delegates at the convention intended to start.

"Resolved, that Messrs. Lafferty, Lake, Grosvenor and Professor Burr be constituted a committee to draft a letter and send it, together with these resolutions, to each delegate to the convention.

"Each member of the board present then tendered his resignation, to take effect at 8 p. m. Monday evening, March 15, 1920, which was in each case accepted by the other members of the board."

The following gentlemen have, it is understood, already consented to serve on the "board of governors" of the organization which will be behind this laboratory: Prof. Wm. A. Burr, C. E., ex-member Isthmian Canal Commission, 165 Broadway, New York City; Chas. F. Chandler, Ph.D., Chemical Foundation, 118 Broadway, New York City; H. F. Cuntz, consulting engineer, 7 East Forty-second street, New York City; Dr. Lee De Forest, Radio Foundation, 1321 Sedgwick avenue, New York City; Major Howard Elliott, Waldorf Astoria, New York City; Dr. W. M. Grosvenor, consulting chemical engineer, 50 East Forty-first street, New York City; John Hays Hammond, Jr., Hammond Laboratory, Gloucester, Mass.; Thomas Howard, chairman executive committee, National Institute of Inventors, 118 Fulton street, New York City; R. C. Lafferty, architect, 347 Fifth avenue, New York City; Simon Lake, president Lake Submarine Co., Milford, Conn.; Francis W. Luellen, vice-president, Individual Drinking Cup Co., 52 Broadway, New York City; W. S. Landis, American Cyanamid Co., 511 Fifth avenue, New York City; Alfonse Monuese, Duparquet, Huot & Monuese Co., 110 West Twenty-second street, New York City; Prof. J. C. Olsen, secretary, American Institute Chemical Engineers, Polytechnic Institute, New York; Noel S. Statham, president, West Virginia Paper & Pulp Co., 200 Fifth avenue, New York City; Dr. Chas. P. Steinmetz, General Electric Co., Schenectady, N. Y.; and Lawrence A. Subers, chairman executive board, Buckeye Rubber Production Co., 304 National City Building, Cleveland, Ohio.

Spoilage of Canned Goods

Research Laboratory of the National Cannery Association Has During the Past Year Conducted Careful Investigations Into the Cause and Prevention of Spoilage.

By W. D. BIGELOW, Ph.D.
Chief Chemist, National Cannery Association

STERILIZATION as applied to canning has for its purpose the destruction of micro-organisms which might otherwise cause the spoilage of the product. In the past this question has been studied in a negative way; that is, without the knowledge of the kinds of bacteria which might be present.

During the last year the research laboratory of the National Cannery Association has been studying this matter with a view to obtaining positive information, and it is believed that true progress in the processing of canned foods can thus be made.

Taking the matter up from this point of view, the research laboratory of the National Cannery Association has studied several types of spoilage in canned foods. Usually the spoilage was due to the fact that the cans were not properly closed. Where the cans were tight the spoilage was apparently due to understerilization, and the bacteria which produced the spoilage have been separated and studied. The heat penetration of various kinds of canned foods is also being determined. By putting together the results of these two investigations information is being secured which it is hoped will have a fundamental bearing on the processing of canned foods.

The bacteria, yeasts and molds which produce decomposition are minute plants. We can understand better the differences that occur among them and their varying properties by considering some of the properties of and variations in larger plants.

We have not given particular attention to the small microscopic plants (such as bacteria, yeasts and molds), and are likely to think of them as few in number and as quite uniform in their vast accomplishments. As a matter of fact, they differ among themselves quite as much as do the trees, shrubs and grasses.

Yeasts have no spores and are easily killed by boiling and molds are usually killed at low temperatures. When mold spores resist processing they will not usually grow in the absence of oxygen, as in a sealed can. Spoilage in canned foods, therefore, when it occurs in a tight can, is almost always caused by bacteria. The properties of these bacteria vary among themselves enormously; in the acidity of the soil (or food) in which they grow; some in the presence of considerable acid as in the ordinary fruits, and others in a product that is slightly alkaline.

Fortunately, bacteria which produce spores, and hence require considerable heat for their destruc-

tion, will not grow in the ordinary fruits. For this reason the temperature of boiling water is sufficient to sterilize fruits and tomatoes. Some organisms produce gas and hence form "swells" when they grow in a sealed can. Others produce acid and form "flat sours." Others (perhaps indirectly) have the property of changing starch to sugar. Others produce a bitter principle, the nature of which has not been ascertained. Some bacteria grow at a relatively low temperature, and do not grow readily at temperatures much above 100 degrees F. Others grow only at higher temperatures, some of them not growing much below 110 degrees F., and growing at high as 170 degrees F.

There have recently come to our attention a number of instances of the spoilage of corn which had been given a process that would ordinarily insure its keeping. In some instances swells developed; in others flat sours. We have isolated the bacteria causing these various kinds of spoilage and have determined the time necessary at each of several temperatures to kill the spores of the organisms.

Most of the organisms causing spoilage in canned corn are of the class known as thermophiles (heat lovers) which grow at a higher temperature than the ordinary type of bacteria, and, if packers were more careful in cooling their corn after processing, much of the spoilage could be avoided.

We suggest three precautions that should be observed with a view to avoiding swells and flat sours in corn as far as possible. First, the corn should be processed at 250 degrees F. and for as long a time as its color will stand. When Maine style corn is processed for 60 minutes, as is the practice in some plants, the majority of bacteria are destroyed, but a process of 250 degrees for 80 minutes is necessary to destroy more resistant spores. Second, corn should be thoroughly cooled before it is stacked solid in the warehouse.

Third, the consistency of corn should not be too great. A good body is, of course, desired, but the greater the consistency the longer is required for the heat to penetrate to the center of the can.

Heat penetration in corn can be greatly increased by the use of a rotating cooker. The research laboratory of the National Cannery Association has given considerable attention during the last year to the study of heat penetration in canned corn.

Peas are usually processed at a temperature of 240 degrees. With No. 2 cans about five minutes are allowed for the retort to reach that tempera-

ture and about five minutes later the center of the can reaches retort temperature. No. 10 cans of peas are also processed at 240 degrees, but from eight to ten minutes is often allowed for the retort to reach that temperature, and the center of the can reaches retort temperature about ten minutes later. The rotation of the can during processing has little influence on the heat penetration of canned peas.

Formerly spoilage because of lack of sterilization with peas was not altogether uncommon. In recent years a process of from thirty-five to forty minutes has been employed and there has been little spoilage with peas from that cause. The organisms causing spoilage were very resistant to heat, but unlike the true thermophiles mentioned above, they grew and caused spoilage at ordinary temperatures. The laboratory is now determining the length of time necessary to destroy these organisms under the ordinary conditions of processing peas.

Evaporated milk is usually processed at a temperature of 240 degrees, and sometimes a lower temperature is employed. The time of processing varies according to the custom of the plant and the character of the milk. We have isolated six distinct organisms whose spores are sufficiently resistant to withstand heating in milk to the temperature of 240 degrees for a longer time than manufacturers can for a moment contemplate in sterilizing the product.

From observations made during the last year it appears that the amount of spoilage caused by organisms of this kind is greater than it is ordinarily believed. It does not appear possible that they came from the udder of the cow. It appears far more probable that their presence in this milk is

due to contamination after the milk is produced. It is to be expected, therefore, that the general movement among packers of evaporated milk, which has already resulted in a marked improvement of their raw product, may result in the elimination of these resistant organisms to a considerable extent.

The three possibilities that suggest themselves along this line are, first, sterilizing for a longer time at the present temperature; second, using a higher temperature; third, the use of a process or device that will carry the retort temperature more quickly to the center of the can. In heating the milk with present processing appliances to a temperature of 250 degrees, it is believed that the milk near the walls of the can would be discolored before the center of the can has been at a sterilizing temperature.

The influence of rotation on heat penetration of evaporated milk does not appear to have been considered.

The resistant organisms we have found in evaporated milk during the last year may be divided into three classes; one which caused the acidity of the milk to increase very slowly during storage, so that a year after its manufacture the milk had curdled and its acidity became very high, two which caused milk to become bitter. In both cases the manufacturers failed to recognize their trouble as due to spoilage. One of them believed that the bitter taste was due to chemical change in the milk. The other attributed the change to imperfection in the tin plate. Two organisms were isolated which caused milk cans to swell and burst.

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* A composite report of several addresses before various sections of the "Canners' Convention."

Dye Manufacturing Costs in America

MANUFACTURING costs of dyes in the United States at the present time are from two to five times greater than were the German selling prices to American consumers before the war, the Tariff Commission reported to Congress in dealing with the new industry of the country. However, the commission showed that the American costs are lower in most cases than the prices at which German dyes were offered to the Reparation Commission, with the value of the mark at par.

It was warned by the commission that it should not be concluded from the report that American dye producers can compete with foreign manufacturers in all parts of the industry. In some classes of products such as vat and alizarin colors, not included in the commission's report, the foreign producers yet have a competitive advantage born of long practice in complicated productive processes, the commission declared.

Continuing, the commission declared in its report: "The cost records were not kept on a uniform basis and reflect cost situation with varying degrees of accuracy.

"Mistaken conclusions growing out of inadequate cost records may not be so serious as those caused by chaotic productive conditions. Unless a more detailed study of variations in cost among the several plants is presented great differences of opinion may arise as to the future of the dye industry in this country from the study of average cost figures alone.

"The average costs of such well established products as sulphur black, nigrosine and direct black are found to be increasing in recent periods.

Present costs of American made products are from two to five times higher than the pre-war price of dyes and intermediates laid down in this country from Germany.

CHEMICAL INVESTIGATION EFFICIENCY & CONTROL

CONDUCTED BY

CHARLES B. DAVIS, F.C.S.



ALL classes of work covered by the following subjects will be done for readers of The Chemical Engineer through this department: special research of every description; analysis and reproduction of any commercial product; prevention of waste and utilization of by-products on the most economical basis; valuation of raw materials; food analysis, and disputed points in regard to adulteration, labeling, and the enforcement of pure food laws; bacteriological and enzymatic examinations, including fermentation tests, pure yeast cultures, beverages of all kinds;

development of chemical inventions and industrial processes; examinations and advice on special machinery. Inquiries of a minor character will be answered on this page, while major matters involving personal investigations, analyses, etc., will, if desired, be treated confidentially through the mails. All questions, materials for analysis, or letters leading to the opening of negotiations for special work will receive prompt attention if addressed to Inquiry Department, The Chemical Engineer, 118 E. 28th St., New York City.

S. Z. M.—The method for inter-converting the three thermometer scales is:

Centigrade to Fahrenheit: Multiply by 1.8 then add 32.

Centigrade to Reaumur: Multiply by 4 and divide by 5.

Reaumur to Centigrade: Multiply by 5 and divide by 4.

Reaumur to Fahrenheit: Multiply by 9, divide by 4, add 32.

Fahrenheit to Centigrade: Subtract 32, then divide by 1.8.

Fahrenheit to Reaumur: Subtract 32, multiply by 4, divided by 9.

E. H.—The deliquescent nature of your last batch of tobacco has been found by careful investigation to be due to the presence of hydrated alkali. The best way to remove this defect will be to sprinkle it with the solution we are sending you by mail. The quantity mentioned on the label must be followed as otherwise it will dry out too quickly.

D. F. O.—Microscopical test shows your apricot wine cloud to be due entirely to cultivated yeast in a state of fermentation. If you will allow it to stand in a cool place for about two weeks, fermentation will then be complete, and the wine will clear of itself. After bottling I would advise that you put it through the process of pasteurization.

T. W. F.—Your question is fully answered in this column for January under J. C. T.

For a small charge, we will undertake to determine the percentage of nitrogen in the various samples you mention.

O. A.—The fibre of your cloth is composed entirely of cotton, but the breaking strength of these fibres is far below normal. This is caused by the dye used containing free acid. There is nothing that can be done other than to return the entire shipment to the makers.

The bleaching salts submitted we are investigating. Results will be forwarded.

J. A. P.—The method for preparing methyl violet on a manufacturing scale is far too long to print in this column. If you so desire, we will forward the data by mail. Please state in your letter if the general layout of the chemical plant for this class of dye is of interest to you also.

A. M. P.—We appreciate honest criticism at all times, but it is absurd for any one to question the corrections referred to as the refractory condition of materials is a result obtained by special tests covering its physical condition. And it is beyond the powers of any chemist to judge from the chemical or rational analysis alone whether or not it is refractory.

If A. M. P. would like this branch of the science explained to him it could be done confidentially.

C. J. S.—We can supply you with complete working formula for preparing Tri-Sodium Phosphate in the crystalline form. The formulas you give in your letter are both incorrect, an acid is first form and then the salt.

W. C. P. Co.—Thermit is a patented product and can be procured from any chemical house. We are in position, however, to supply working formula for preparing the liquid and dry Lime-Sulphur insecticide.

H. C. S.—Your letter together with sample of paint oil has been received and its chemical analysis will be proceeded with as requested. We anticipate no difficulty as regards its reproduction.

W. L. G.—Your brewery is well fitted for the manufacture of ginger ale, and we can supply a formula producing a sparkling product equal to the best imported. The list of anilin dyes permitted for food products will be forwarded when requested.

P. E. H.—We are looking into the matter of hide and skin tanning and you will hear from us at a date in the near future.

S. P.—On testing your yellow dye sent us some time ago we find it to be the Potassium Salt of

Dinitroalphanaphtholsulphonic acid. This is known in the trade as Naphthol Yellow. You are right in using this for dyeing your wool and silk, as it is best suited for these fabrics.

L. F. E.—Your two samples of Monel Metal marked "A" and "B" have been analyzed with results as below tabulated:

	"A"	"B"
Nickel	66.60	66.15
Copper	28.65	28.40
Iron	2.28	2.46
Manganese	1.98	2.30
Aluminum	0.18	0.40
Carbon	0.28	0.25
Silica	0.03	0.04
	100.00	100.00

It will be perfectly safe for you to store your oils in vessels of this alloy.

P. A. V.—We are sending you the complete apparatus for detecting and determining minute quan-

ties of arsenic in all types of materials. Also the chart consisting of the color standards. With these you will be in a position to determine less than one part arsenic in 1,000,000 of sample.

S. L.—Both loaves of bread submitted for test has been found to contain ammonia salt. This is no doubt due to using too great an amount of your baking powder. As the pure food law is sure to interfere, we recommend that you change to a tartrate powder in the future.

D. B. M.—The ink contained in your typewriter ribbon is now under investigation. Complete data will be forwarded as soon as this is finished, but we can state definitely at this time that the smeary nature is due to an excess of glycerine.

P. A. N.—An article on the Edge bill appeared in the December issue of this journal. We will be pleased to forward you a copy of the paper if you so desire.

American-Scandinavian Foundation Scholarships

THE traveling fellowships established by the American-Scandinavian Foundation of New York City promise to rival the Rhodes scholarship plan in interest aroused among American colleges. Twenty fellowships, each with a stipend of at least \$1,000, and in some cases \$1,200, will be awarded in May to American students, men and women, for technological research and humanistic study in the Universities of Sweden, Denmark and Norway. When it was announced a year ago that young American engineers and students of science would be given opportunity to study under such eminent scientists as Svante Arrhenius, founder of the theory of electrolytic dissociation, or Hjalmar Lundbohm, director of operations on the great iron mountains at Kiruna, officials of American technological institutions recommended for consideration the names of promising recent graduates. The men who were appointed, and who are now in Sweden, represent the best known scientific schools from Massachusetts to Wyoming. It is required that all candidates be of American birth, and all of these men had rendered scientific or military service in the army of the United States.

Since that time, the scope of the fellowship plan has been greatly extended. The number of fellowships has been doubled so that five students will be sent to Denmark and five to Norway in addition to the ten to be appointed for Sweden. Not only will Fellows be appointed for the study of chemistry and physics, hydro-electrical engineering, metallurgy and forestry—in all of which subjects Scandinavian countries excel—but also for agricultural sciences and for language and literature. Denmark's agricultural system and her system of folk high schools have attracted

to Denmark many an educational commission from foreign countries; and English literature has drawn freely from the North from the time of the sagas of Beowulf to that of the tales of Hans Andersen. Fellows will also be appointed to Norway for the study of oceanography, the new science of the sea fathered by Fridtjof Nansen and Helland-Hansen; and for the study of weather forecasting under Professor Bjerknes of the Bergen Geo-Physical Institute.

Application papers, with letters of recommendation, must be filed at the office of the American-Scandinavian Foundation at 25 West 45th Street, New York, before April 1. The selection of Fellows will be made by a jury of university professors and technical experts appointed by the Foundation and on this jury are William Hovgaard, professor of naval architecture, Massachusetts Institute of Technology; C. H. Marvin, Chief of the Weather Bureau, U. S. Department of Agriculture; J. W. Toumey, dean of the School of Forestry at Yale; H. P. Talbot, chief of the department of chemistry, Massachusetts Institute of Technology; A. E. Kennelly, chief of the department of electrical engineering at Harvard; William Campbell of the department of metallurgy, Columbia University; W. W. Lawrence, professor of English at Columbia University, and Henry Goddard Leach, secretary of the Foundation.

Successful candidates will be notified about May 1 and are expected to sail from New York in early summer, so that they may have several weeks before the opening of the universities, to travel about in the countries to which they are appointed, familiarizing themselves with the language and life of the people.

Illuminating Gas and Gasoline Removal

Investigations Conducted by the Bureau of Mines Prove Conclusively that the Removal of Gasoline from Natural Gas Does Not Lessen Its Heat Value.

THE popular belief in the more than 2,100 towns and cities of the country where natural gas is used that the gas is being robbed of some of its heat value by the gas companies at the time when most needed, through taking the gasoline from the gas, has been rudely upset by the Bureau of Mines, Department of the Interior, in a series of investigations just completed, which show that the more than 2,000,000 natural gas consumers lose practically no heating value through the process. In fact, taking all of the factors involved in this problem that have proved so troublesome and so misleading, and the Bureau of Mines claims that the taking of the gasoline from the natural gas is a benefit to the consumers and to the whole country, rather than a detriment.

It seems that whenever the weather becomes severe in a place where natural gas is used, and the gas pressure becomes low, some one is always ready to suggest that there are gasoline-making plants along the natural gas main lines that make it a business to take out what little gasoline remains in the pipes, thus impoverishing the gas. It is shown that the gasoline itself is rich in heating value, and taking it away, therefore, robs the gas. During periods of low pressure in winter when there is a shortage of gas, many good citizens have felt that they have been doing a service in behalf of the people in making complaints through the courts or legislative bodies against this "robbing of the gas," and because consumers have not received competent scientific advice from disinterested sources, there have grown up needless misunderstandings and a waste of efforts on negligible factors concerning the gas supply.

In an endeavor to settle the question for all time and for the benefit of the natural gas using public and the good of the entire country, the Bureau of Mines went thoroughly into the subject, with the result that the following conclusions have been drawn by Dr. Van H. Manning, director of the bureau.

In general, the decrease in heating value of natural gas from the removal of gasoline is greatly overestimated. One gallon of gasoline in the natural gas burned by the domestic consumer as gas is worth to him about 1¾ cents in heat value, while this same gallon of gasoline to the automobile owner is worth 25 to 30 cents. Taking the gasoline out of the gas, one gallon will equal 35 cubic feet of gas, but this is not taken from the consumer, because his gas is measured at his home meter and he obtains 1,000 cubic feet of gas, irrespective of whether the gasoline is removed or not.

The Bureau of Mines has even reached the conclusion that the removal of the gasoline from the natural gas is a positive benefit to the consumer. Without these gasoline plants great difficulty has been found by the gas companies in the condensation of the gasoline and water in the pipe lines, the gasoline and water disintegrating the rubber gaskets in the couplings, resulting in a large leakage of gas and the consequent lowering of the pressure. Therefore, the taking of the gasoline is a safeguard to the consumer that he will not be without gas at serious times by reason of leakage. The installation of these plants eliminates most of the line trouble and gives better service to the public. On the whole, the Bureau of Mines considers the extraction of gasoline from natural gas a great conservation measure and desires to encourage this industry.

Furthermore, several hundred million gallons of gasoline of the highest fuel value and adaptability are added to the country's supply, which the bureau avers would be practically wasted if not taken from the pipes.

There is still another reason, as the bureau sees it, for extracting this gasoline from the natural gas. All gasoline obtained in this manner has what is known as a low boiling point; that is, it vaporizes easily, and this makes it valuable in starting automobiles, especially in cold weather. So valuable is this gasoline for this purpose the refiners use all this supply in blending with straight-run gasoline with a higher boiling point in order to produce a gasoline that the automobiles can use without difficulty. The importance of this is seen in the belief that if the refiners were deprived of this gasoline from natural gas for blending purposes, the automobiles of the country would have more difficulty in using the gasoline now on the market. It is even possible that the absence of this high quality gasoline might precipitate a crisis in the gasoline market.

The Bureau of Mines sums up from its investigations that the loss from extracting the gasoline from natural gas is insignificant and inconsequential when compared to the advantages attained, not only to the producer and distributor of gas, but also for the domestic consumer of natural gas.

The British Board of Trade Journal is authority for the statement that figures were recently laid before the New Zealand House of Representatives to show that the Island of Nauru in the Southern Pacific contains from 80,000,000 to 100,000,000 tons of phosphate, enough to supply the needs of the world for two hundred years. The quality of the phosphate is said to be from eighty-five to eighty-six per cent. The annual output of this island is now about 150,000 tons.

American Electrochemical Meeting

Boston Meeting to Be Held April 8 to 10. An Interesting Program Has Been Prepared and the Attendance Will Likely Be Large. A Number of Prominent Men to Speak

THE Boston meeting of the American Electrochemical Society will be held in Boston early in April and from present indications promises to be both interesting and well attended. A program of wide scope has been prepared and a large number of the members of the organization have already signified their intention to attend.

Following is the program planned in detail:

Wednesday Evening—Meeting of the Board of Directors.

Thursday Morning—Annual Business Meeting. Address by the retiring president, Wilder D. Bancroft, "Contact Catalysis." *Symposium*: "Colloid Chemistry." W. D. Bancroft, "Colloid Chemistry and Electrochemistry"; W. A. Deane, "Settling Problems"; T. R. Briggs and W. J. Bartlett, "The Adsorption of Arsenious Oxide by Actastannic Acid and the Purification of Spent Electrolyte"; G. A. Hulett, "Graftic Acid, a Colloidal Oxide of Carbon"; A. C. Fieldner, "Determination of Graftic Carbon"; William C. Moore, "Selective Absorption by Bacillus Pyocyanus."

Thursday Afternoon—Guy Clinton, "A Criticism of Kohlrausch's Law of the Conductivity of Solutions"; H. D. Holler and L. M. Ritchie, "Hydrogen Iron Concentration in Dry Cells"; D. A. MacInnes, "The Reactions of the Lead Accumulator"; William Roy Mott, "Arc Images in Chemical Analysis."

Friday Morning—Joint Meeting with the American Institute of Electrical Engineers. W. D. Bancroft, presiding. *Symposium*: "Electrically Produced Alloys." H. E. Howe, "Fundamental Problems in Alloys Research"; R. J. Anderson, "Recent Developments in the Ferro Alloy Industry"; C. B. Gibson, "The Manufacture of Ferro Alloys in the Electric Furnace"; B. D. Saklatwalla, "Ferro Vanadium"; Ellwood Haynes, "Stellite"; F. A. Raven, "Properties of Ferro Silicon"; E. S. Bardwell, "Ferro Manganese"; R. C. McKenna, "The Manufacture of

High Speed Steel in the Electric Furnace"; Alean Hirsch, "Ferro Cerium"; Theodore Swann, "Ferro Zirconium"; B. C. Flugh, "Ferro Phosphorus"; R. M. Major, "Nichroms and Other Special Alloys"; T. D. Yensen, "Electric Properties of Nickel-Iron Alloys"; N. A. Hunter, "Electrical Properties of Titanium Alloys"; C. F. Harding, "Nitrogen Fixation by the Silent Discharge."

1:30 P. M.—Trip to Lynn Works of the General Electric Company.

6:30 P. M.—Informal Subscription Dinner at Copley-Plaza Hotel.

8:30 P. M.—*Symposium*: "Power for Electrochemical Industries." President C. Townley, of the A. I. E. E., presiding. John L. Harper, "Power for Electrochemical Plants"; John A. Seede, "Automatic Control of Arc Furnace Electrodes"; H. A. Winne, "Reactors for Electric Furnace Circuits"; C. A. Winder, "Economics of the Power Situation"; E. A. Wilcox, "Electric Furnace Power from the Standpoint of the Central Station"; H. L. Hess, "The Electric Furnace and the Central Station"; C. T. Maynard, "Location of a New England Electrochemical Plant"; F. F. Fowler, "Water Powers of the Pacific Coast"; J. W. Beckman, "Power Development in Scandinavia"; W. G. Berlin, "Power Problems from the Standpoint of the Furnace Operator."

Saturday Morning—Harvard University. J. W. Richards, "The Soderberg Self-Baking, Continuous Electrode"; Charles A. Jeller, "Synthetic Electric Furnace Pig Iron"; Philip B. Short, "Step Induction Regulators for Electric Furnaces"; Clarence J. West, "The Electric Furnace as Applied to Metallurgy"; H. M. St. John, "The Electric Brass Furnace, Its Evolution"; L. B. Lindemuth, "The Electric Furnace in Iron and Steel Metallurgy"; Edward F. Kern, "Reduction of Manganiferous Silicate Slags."

Saturday Afternoon—Visit to the Huff Electrostatic Separator Company.

Absorption Process of Gasoline Recovery

A PAPER dealing directly with the recovery of gasoline, by means of the absorption process, from residual gas in plants where motor fuel is obtained from natural gas by mechanical compression and cooling, has just been issued by the Bureau of Mines, Department of the Interior, as Technical Paper 232, W. P. Dykema and Roy O. Neal, authors. In the absorption process the gasoline present in the natural gas is absorbed by oil and subsequently separated from the oil by distillation or is absorbed in naphtha and marketed without any further treatment.

The purpose of the paper is to point out more efficient methods of production of gasoline and

motor fuel. When we take into consideration the vast amount of motor fuel being consumed at the present time, and particularly the rapid advance in consumption of the product, due to the increase in the manufacture of automobile trucks, tractors, etc., that has taken place over a very few years, we need no further argument to convince us that conservation is a paramount problem and that any method which tends toward increasing the yield from our present resources is a very important one. This paper deals directly with one method which may be used for obtaining a greater extraction of gasoline from our natural gas.

The investigation was carried on by actual field

demonstrations and from the thirty plants tested throughout the Mid-Continent field it was ascertained that there still remained in the gas after it has been subjected to final treatment in the plant an average of .337 gallons of gasoline for every thousand cubic feet. The cost of auxiliary equipment necessary to treat this residual gas is justified, for it has been proven already by practical demonstrations that such equipment is soon paid for by the

general increase in efficiency of the entire plant.

Recommendations regarding the installation of equipment are made in this paper which will prove of interest to anyone contemplating such construction work.

Copies of this publication may be obtained free of charge by addressing the Director of the Bureau of Mines, Washington, D. C., or from the Service Department of this magazine.

Canadian Opinion and the Pulpwood Embargo

THE attitude which Canadian paper men take in regard to the movement inaugurated by Senator Underwood to induce the Canadian provincial governments to lift the export embargoes on pulpwood cut on Canadian crown lands, is expressed as follows in a recent issue of the "Pulp and Paper Magazine," a Canadian publication generally regarded as the leader in its particular field:

"A recent report from Washington intimates that a certain senator has the idea that an ailment affecting a certain group of American citizens will be cured by having somebody else take the medicine. His idea is that an American commission might so influence Canadian governments, federal and provincial, that restrictions on the shipment to the United States of pulpwood cut on crown lands would be removed and thereby the raw material for some short-sighted (but in a war far-sighted) paper mill managements might be assured an extensive supply of relatively cheap raw material without the inconvenience of making provision themselves for such supply. The fact that such restrictions as the province has deemed wise to enforce were instituted for the protection of a fundamental Canadian industry which provides for the support of several hundred thousand Canadians, does not seem to enter into the senator's calculations. He does, however, recognize, as a good many speakers on the subject have failed to do, that the matter is one in the hands of the provincial governments and that while the provincial government has not the power to institute an export embargo, yet the equivalent is obtained by simply requiring as a condition on a lease of crown timber lands that the wood cut therefrom shall be manufactured in the province or possibly in the Dominion.

"The pulpwood and timber under the control of the federal government, while fairly extensive in the aggregate, is in large part not of a character at present largely used in the manufacture of newsprint paper and in large part also is not conveniently accessible to pulp and paper plants. That is practically the end of the federal government's connection with the matter, except in so far as their advice might be listened to by provincial authorities.

"The senator's assumption that the introduction without restriction of pulpwood cut on crown lands

would reduce the price of newsprint or even make it more easily obtainable, will hardly bear serious consideration. Paper mills equipped to make newsprint and desiring to do so are not at the present time suffering very much for want of raw material. They are operating to the limit and the prices asked are willingly met by the consumers of their product, who would even be glad to pay still higher prices if they could get a larger amount of paper. There is thus no necessity at the present time of making newsprint at a lower cost or selling it at a cheaper price as far as the ability of the consumer to pay the current rates is concerned. The principal difficulty is one of the distribution of available supplies and the demand of the business public for the product of the publisher is the real reason for the extensive demand for the product of the paper maker. The importation of more wood from Canada to the United States does not seem to be an important factor in the present state of affairs.

"There has been some talk of even tightening up on the amount of pulpwood exported from privately owned lands. This is a matter for the most careful consideration, as a number of factors come into that problem which do not enter into the consideration of the question of wood from crown lands, and action along this line may not be anticipated for some time. There is, however, in this connection the possibility that Canadian mills, realizing the need of conserving their own holdings, will see the advantage of purchasing much larger quantities of pulpwood in the open market. They are in a better position now than ever before to compete with American mills in the purchase of such wood as settlers and farmer may have available. Such action, however, would have a more serious effect on some American mills than the crown and restrictions have ever worked. It might hasten the moving on of the American newsprint industry westward to the great Rocky Mountain forests and would certainly hasten the reforestation of denuded forests in the northeastern and central states. Work begun along this line now would permit a re-establishment of this important industry in sections where it is now faced with starvation for want of raw material. This starving of some wood-consuming mills across the line

which depend on Canadian wood is practically inevitable, because the wood available from Canadian farms is, of course, growing less as the farms become more fully cleared and the as governments take proper steps to prevent the stealing by settlers and farmers and jobbers of wood from crown lands which border the areas on which cutting for export is legitimate. Along this line, it might be mentioned that with the institution of forward-looking cutting regulations on crown lands there is an obligation on the administration of our forest policy to

require the observance of proper forestry practice by those who are cutting on any lands that are not immediately required for agricultural purposes.

"The senator's idea of a commission may have been made with the best intentions for helping the American manufacturer, but there does not seem to be any possible chance for his proposition to succeed either in regard to removing present restrictions on the export of pulpwood or in regard to his rather deluded notion that such a move would result in more or cheaper newsprint to the American."

Chemical Manufacturers to Eliminate Waste

AGREEMENTS entered into between large chemical companies within the last few days point the way to the reduction of living costs through new methods of utilizing waste products, according to a bulletin of the American Chemical Society.

One company, which produces ammonia by the fixation of nitrogen from the air, will exchange its unused substances for materials rejected in the manufacture of soda.

By the Haber process, a German method, the patents on which were taken over by the Chemical Foundation, Inc., ammonia can be obtained on a large scale from atmospheric nitrogen. The chief item of expense in this process is the cost of obtaining and purifying the hydrogen needed to bring about the necessary reactions; as a large bulk of material must be handled to get it. Thus eleven tons of carbonic acid gas or carbon dioxide, such as is used in the charging of soda water fountains, are obtained for every ton of pure hydrogen. This carbon dioxide was permitted to escape into the air.

On the other hand, the manufacturers of soda and its compounds need carbon dioxide in vast quantities. They have been burning up hundreds of carloads of coal and limestone to get that which the corporations making ammonia by the fixation of nitrogen were sending adrift upon the winds. Under the new agreements, the soda manufacturers take over the carbon dioxide from the ammonia plants and pass it through heavy brine. This brine, as all of us remember from our high school chemistry, is a solution of common salt or sodium chloride in water. Salt is composed of sodium and chlorine. The carbonic acid gas, bubbling through the brine, unites with the sodium and forms a bicarbonate or the baking soda which is used by the housewife in so many domestic chemical reactions. There is also formed chloride which can be employed as fertilizer.

In the manufacture of soda, much lime or calcium oxide and chlorine were required. There has always been a great waste of the calcium chloride which is left as a residue. This sludge, as it

is called, has been puzzling the chemical economists for years. It is an inert substance, and not of such value as is chlorinated lime, incorrectly designated chloride of lime, which is a disinfectant and bleach. Sludge is an economic misfit. A certain amount of it, however, when dried is useful as a dressing for roads, where it keeps down the dust, as it quickly absorbs water.

Public-spirited chemical manufacturers, desiring in every way to co-operate with the conservation commissions of the various states, have kept it out of streams wherever possible, as it tends to injure the fish and to destroy vegetation along the banks. They have been piling it up in great masses, thus losing the use of valuable real estate. Under the new arrangement sludge will not be produced. Instead, the plants engaged in nitrogen and ammonia operations will be getting ammonia in a form suitable for direct application to the soil as a fertilizer, for the ammonium chloride obtained under the new methods is a valuable and highly concentrated nitrogen product. It is considered as good as the ammonium sulphate obtained by the treating of ammonia with sulphuric acid.

The team work arranged for the two processes is bound to result in lower production costs. This means that cheap and abundant fertilizer, so necessary to the increase of the crops, will be at hand. There will be saved also hundreds of thousands of tons of sulphuric acid, hundreds of thousands of tons of lime and many a trainload of coke.

Such methods are the beginning of an era into which has come the saving grace of the Great War. The cutting off of the United States from its chemical trade with Europe made it necessary for manufacturers to seek new sources of chemicals and they found them often in the dust heaps. Under the new regime, substances once considered useless may be turned to good account by merely transferring them by pipe or tram to some other part of a plant, or to a neighboring establishment with which an arrangement has been made for the taking over of the waste. Thus new and important products may be evolved from waste.

The Need for Oil Production Engineers

According to the Bureau of Mines Trained Men Are Needed in the Oil Fields Who Correspond to the Mining Engineers in the Mining Industry. Must Have Knowledge of Geology and Chemistry to Qualify.

A NEED exists for men in oil field production work who correspond to the mining engineer of a large mining property. Some oil companies prefer to call such an employee a resident geologist, resident engineer, or a petroleum technologist. He should, perhaps, be more correctly termed a petroleum production engineer. The duty of such a man is to apply his scientific and geologic training practically to oil-field development work.

He should be, by education, a mining, civil, or mechanical engineer, with a knowledge of geology and chemistry. Upon completion of his education, such a man should spend several years in the oil fields. There are two means of gaining proper experience. The first method is to work for an oil company in making a detailed study of each well, collecting data on the history and production, followed by a preparation of good records, from which well logs can be prepared. From the well logs, the geologic cross-sections, peg-models and structure contour maps can be made. These allow a comparable, detailed study of each well, which is necessary to solve many of the problems. Along with this the engineer should visit drilling wells daily for collection of samples of formations and for a proper study of how they drill. He should form friendly relations with the drillers and production foremen. The second method of gaining proper experience is to start work as a roustabout, pumper, or on the pipe-line gang, finally working up to a tool dresser. After three or four years of such work, the engineer may be classed as a petroleum production engineer.

It is unfortunate, but true, that often there is a strained relation between the technical and non-technical man. Now a fundamental purpose in the handling of a property is efficient operation, which cannot be best effected until this estrangement is done away with. There is no reason why most cordial relations cannot be established between the driller and the engineer, provided a little leniency is shown on both sides. Each should realize that the other is a specialist in his own work. The engineer should appreciate that the records of conditions underground as shown in well logs, histories, etc., are largely the results of the driller's observation. He should discuss with the driller the practical application of engineering methods so that the latter will take particular care to collect formation samples, fossils, or other data needed in solving the en-

gineer's problems. The driller is most familiar with the formations, as he understands how they drill, so each day the engineer should discuss the daily well report with the drillers.

The duty of an engineer experienced in oil-field development is to direct the work* outlined below:

1. Keeping of records.
2. Preparation of data, such as production records, well logs, structure contour maps, cross-sections, etc.
3. Correlation of surface and underground geology.
4. Water problems.
5. Casing depths.
6. Underground losses.
7. Oil sands; location of productive sands, their thickness and quality of oil.
8. Well depths.
9. New well locations and extension of the field.
10. Future well production.
11. Gaging of oil wells.
12. Perforations and setting screen pipe.
13. Fluid levels and tubing depths.
14. Shooting of oil wells.
15. Methods of extracting more oil from the oil-bearing formations.

At first his responsibilities will be limited until he has been able to work out the underground conditions on the property and to have his records, data, and other information compiled in such a form that they are readily accessible. As he becomes more experienced and proficient he will be able to take over more and more of the operating side until he becomes a very valuable adjunct to the management.

One of the most important duties in the oil fields is to collect the proper kind of data, and, in the case of those companies where records are incomplete and have not been properly kept, forms should be prepared immediately for the collection of desired data.

The wells should be gaged daily, both for oil and for water. Exceedingly valuable information will thus be built up which will be worth its cost many times over in the life of the property. The water content will be useful in locating the source of water troubles. The production records will give valuable data as to the future worth of the property; also the effect the various methods of operation have on the production of individual wells and the property as a whole; for example, the application of vacuum pumping, the effect in shooting wells, etc.; also in the later life of the property it will enable the producer to determine which wells are profitable and which are not, and many other similar things of importance.

* From *Underground Conditions in the Oil Fields*, a Bureau of Mines Bulletin, No. 195, "Underground Conditions in Oil Fields," now in press.

By a study of production records the locations that will likely prove most productive can be chosen. This will take into account the condition of sands and the structure, in order to avoid tight parts of the sand or to avoid parts of the field that will be water-bearing, or, on the other hand, carry gas. Production records are also of value in estimating the future production of wells and of the property.

A very important problem is to locate all water sands and proper casing depths. For this purpose, complete production records and all additional information possible in relation to the wells and their production should be collected. After location of the various water sands any necessary recommendations should be made for the correction of wells making water. When the water sands have been definitely located, it is possible to choose the casing depths, well depths, and well locations, all selected to avoid water troubles.

The knowledge of surface and sub-surface geology permits the selection of well locations that are best situated structurally, or in certain cases the selection of sites that will give definite or desired information as to the future of the field.

Samples of the formations and samples of water should be collected. These may be labelled and stored away for examination if needed. This sam-

pling involves only a small expense and may later prove helpful in the solution of some problem. The engineer should interest the drillers in the collection of these samples and make use of their reports.

All of the above data, which should be collected upon advice of the engineer, should be studied in conjunction with the foremen, and then recommendations prepared for the management. These recommendations should be followed unless the superintendent or others in authority can show to the management that they are at fault. Predictions should be made with discretion, however, and the engineer should be certain that the assembled information justifies the conclusions drawn.

The field work of the petroleum engineer covers every phase of development and production to which science and engineering and geology apply. The tendency is becoming more and more for the engineer to work into the operating side of the business, just as in the mining industry. After a term of years in actual contact with the problems of such work and a study of the practical side of oil-field work, the engineer may become very valuable in operating such a property, as he will then have advantage of education, of the scientific study of the problems of development and production, and will also have the knowledge of practical work and series of valuable assets.

Manjak and Its Industrial Uses

The term "manjak" is applied to a variety of bitumen or solid hydrocarbon occurring on the Island of Barbados, West Indies, and in Utah, Cuba, and Trinidad. The deposits on the latter island are found within a distance of three miles of San Fernando, the second largest town on the Island, and within three miles of the famous asphalt lake.

In chemical composition, manjak is like asphalt. It is almost pure bitumen. Its melting point is, however, more than 400° F., whereas asphalt melts at 100° F. In composition, it consists of 80 to 90 per cent carbon, the balance being chiefly hydrogen, with a small quantity of sulfur. It resembles coal in appearance, is odorless, hard and brittle. It is found in thin beds between layers of clay.

The island of Trinidad is rich in this mineral resource. Its development has as yet hardly begun, and the exportations already made have been with the view of testing out the material. During 1918, exports to the United States were valued at about \$3,100, and in 1919, up to October 1, they totaled 41 tons, valued at \$1,900. Prior to 1900, manjak was mined on a small scale in Trinidad, but for various reasons, very little was done between 1900 and 1913. In the latter year, mining operations were resumed by the Trinidad-Tarouba Oil Development Company of San Fernando. At the present time there are five shafts, one of which has reached a 37-foot bed of manjak at a depth of 400 feet. Operations could be greatly extended if there were a greater demand for the material.

It has not been found profitable to export manjek from Trinidad in the crude state as the price received, namely, \$35 per ton, hardly covers mining expenses. These are increased by the necessity for careful and thorough timbering on account of the clay formation.

Compounds, made by combining manjak with mineral oil command fair local prices which have enabled mine operations to proceed at a profit. Experimentation is still in progress with different mixtures of manjak and oil for various purposes. The Manjek recently sent to the United States was for the purpose of ascertaining

whether American oils would be more economical and useful for mixing with the manjak than the Trinidad oils. It is the plan to erect a plant very soon for the manufacture of a variety of manjak paints and compounds.

Manjak is rapidly increasing in use, particularly in connection with the oil industry. It is produced in close proximity to the oil wells in Trinidad. It is boiled with oils at high temperatures and converted into compounds and paints for nearly every purpose where a preservative is needed, for example, on pipe lines, boilers, chimneys, and miscellaneous iron ware, machinery, etc. It is usually applied in the liquid state, hardening into a tough, rubberlike coating. It has low viscosity, and is not affected by ordinary heat. It makes an excellent insulating material and is impervious to both air and water. In hot and damp climates, like that of Trinidad, where pipe lines quickly deteriorate, their life has been prolonged for extended periods when painted with this material.

The most important use of manjak, and one wherein it has won a reputation for saving money, is in connection with rotary drilling for oil. A soft compound is used on the joints of the pipes between the casing threads and drill stem threads, and this prevents either water, sand, or grit getting into the threads, thus preserving them from being stripped or worn off. It not only acts with particular efficacy in keeping such pipes watertight, airtight, and free from corrosion at the joints, but it also facilitates the work of joining and separating the pipes owing to its lubricating qualities. It has been found much superior to white lead or any other substances previously used for such purposes, and its use results in economy.

The Government of Trinidad is now making use of manjak in painting the under parts of bridges and other structures where protection is required from water. Excellent results have been obtained by using manjak paints and compounds on steel smoke stacks, car trucks, fenders, bidders, and all iron and steel work connected with power-house and car buildings. Their compounds have also been used successfully in the form of insulating,

The Quality of Motor Gasoline

Average Volatility Has Decreased Since 1915, According to Tests Made by the Bureau of Mines. Chief Cause Increased Demand for Gasoline Produced by Development of Motor Car.

FOR a period of several years, beginning with 1915, there has been a continuous change in the quality of motor gasoline. The average volatility has decreased, due to the fact that higher boiling fractions of the crude oil have been included in the gasoline. This change in quality was made necessary by the tremendous increase in the demand for motor fuel, caused by the development of the motor car, and during the war was an absolute necessity to avoid gasoline shortages. The Bureau of Mines has kept in close touch with this situation by making surveys from time to time of the gasoline sold throughout the country, as this information is of value to manufacturers and users of motor cars and also indicates when any changes are required in the Government specifications. The Bureau has just completed a gasoline survey and is in a position to make public the fact that there has been very little change in the quality of motor gasoline in recent months.

During the period from January 17 to February 3, 1920, 81 samples of motor gasoline were collected by representatives of the Bureau of Mines in seven districts of the United States. The cities selected for this survey were New York, N. Y., including Brooklyn; Washington, D. C.; Pittsburgh, Pa.; Chicago, Ill.; New Orleans, La.; Salt Lake City, Utah, and San Francisco, Cal., including Berkeley. In every case the samples collected were taken in such a manner as to represent material actually being sold as motor fuel, and to include samples from each refinery marketing in the district.

About a year previous, in April, 1919, a much more comprehensive survey of the motor gasolines, including more than 800 samples, sold throughout the United States, was made by the Bureau of Mines. Samples were collected in every state and in nearly every important city in the country. The data obtained in this survey were used by the Committee on Standardization of Petroleum Specifications for setting a new specification for Federal purchases of motor gasoline, which was adopted November 25, 1919. The complete report of this 1919 survey is included in Bulletin No. 191 of the Bureau of Mines, entitled "Commercial Gasoline," by H. H. Hill and E. W. Dean. The later survey was undertaken to find out how much change had occurred in the quality of motor gasoline since the 1919 survey, and it is planned to make similar surveys in July, 1920, and in January and July of coming years, in order to observe yearly and seasonal changes in quality of motor gasoline.

The samples were tested in accordance with the methods given in Technical Paper 214 of the Bu-

reau of Mines, entitled "Motor Gasoline," by E. W. Dean, and in Bulletin No. 3 of the Committee on Standardization of Petroleum Specifications. The actual specific gravity at 60° Fahrenheit, the corresponding Baumé gravity, the first drop or initial boiling point, the 20, 50 and 90 per cent. points, the end or dry point, the average boiling point,

When taking up the individual samples, however, several points must be noted. In a number of instances it was found impossible to recover 95 per cent. of the sample in the receiver when using a mixture of ice and water in the condenser bath. This indicates that the sample contains an excess of low boiling fractions, which is probably due to an admixture of too much "casinghead" gasoline. This means that the evaporation loss in use may be excessive.

On the other hand, there are a number of samples which are above the specification at the upper part of the distillation range. When this occurs it indicates either that the refiner did not use modern tower stills, or that an excess of high-boiling naphtha has been used in blending. These samples when used in the average motor car would be apt to cause excessive carbonization and also dilution of the crank case oil.

The Bureau of Mines, therefore, on studying these surveys, concludes that on the whole there has been little change in the nature of the motor fuel marketed throughout the country during the period from April, 1919, to January, 1920, but that refiners should take more care in some cases to avoid an excess either in the use of casinghead gasoline or of heavy naphtha.

According to U. S. Consul O. S. Heizer, located in Bagdad, Mesopotamia, there is a market in that part of the world for American chemicals. Says the consul:

"Prior to the war large quantities of chemical products, principally dyes, were supplied by Germany to Bagdad through a local German firm. Since the beginning of hostilities in Europe, however, no imports of this class have been received, but the enormous stock on hand was quite sufficient to meet the requirements of the country for several years. The chemicals supplied by Germany were adapted to the needs of the country, and it is reported that orders are now being placed by local merchants with their pre-war sources. If competitive prices, as well as facilities in shipment and terms, were offered American firms might expect a large amount of business."

Advertising Chemistry

A. D. Little, Inc., Make Successful Offer of Service

FOR some time back, the Arthur D. Little, Inc., of Cambridge, Mass., have been conducting a national advertising campaign to bring home to the average business man the part, the intensely practical part, chemistry can play in his business and his life. And according to latest reports the campaign is meeting with even more success than was anticipated. An amazing variety of inquiries are streaming into the offices of the Little laboratories. From a shoe manufacturer comes the question, "How may I prevent stains on white shoes?" From another firm comes an inquiry as to the best means of utilizing wood waste. From a manufacturer of hosiery comes the request for information as to the best method of marking hosiery indelibly.

The result of the Little advertising campaign plainly shows what chemists can do to place their services at the disposal of industry. There are a million ways in which they can serve industry but they must use as much intelligence as the Little company in explaining to their prospective clients what they have done and what they can do if they are given the opportunity. The Little advertising is attractive, "up to the minute," and apparently based upon an intimate knowledge of the part chemistry and science can play in industry. Using the same methods, other industrial chemists can be blessed with the same success. The opportunity awaits them.

New Dye Bill Offered

Moses Bill Aimed to Placate Textile Interests

SENATOR MOSES, of New Hampshire, on March 13th introduced a bill as a substitute for the Longworth measure, which places additional duties on imported dyes coming into competition with American products. It is believed it will meet with the approval of textile interests.

The bill provides for a continuance of the existing duties. On dyestuffs similar to goods produced in the United States or to substitutes made here, the bill would impose a duty equal to difference between the reasonable wholesale price of the American goods and the cost of the imported materials, plus an additional duty of 20 per cent. of the wholesale price. Dyestuffs not competing with American products would be allowed to come in at the existing tariff rates.

Another provision of the bill would require all imported goods to be marked truthfully as to the contents, and similar information must be contained in the invoices. Heavy fines or imprisonment are provided for violations of the provisions.

Du Pont Annual Report Company Affected Adjustment to Peace Successfully

THE annual report of E. I. du Pont de Nemours & Co. for the year ended December 31, 1919, covering the first full year of work since the war, shows net earnings of \$11,620,953, a decrease of \$25,600,414 compared with 1918. Net sales last year aggregated \$105,437,932. The report shows a total surplus of \$71,741,304, of which \$3,440,413 was added in 1919 after the payment of \$3,648,822 as a 6 per cent. dividend on the debenture stock and \$10,593,756 as an 18 per cent. dividend on the common shares.

In a statement the company said the estimated undivided profits not reflected in the annual report amounted to \$16,105,713, which is equivalent to \$27.37 per share on common stock. It also said the estimated excess in net asset values of the principal stockholdings of the company over the values carried on the books amounted to \$33,126,623. The largest of these items was that accruing by reason of the earnings of the General Motors Corporation, of which the Dupont Company owns more than 200,000 shares.

"Munition contracts with the United States Government," the statement said, "were cancelled after the signing of the armistice, and since that time continued efforts have been made to reach a settlement of the claims against the Government. The total amount of these claims is \$27,595,377, against which the company holds advance payments of \$20,758,088."

As a result of entering into the production of goods other than explosives, the statement added, the company has been able to retain 31,580 of its war-time employees.

Leather Chemistry

Research and the Production of Leather Belting

TRIBUTE is paid to the service the chemist has performed for one industry, that engaged in the manufacture of leather belting, in a recent issue of the "G. W. W. Bulletin," the house organ published by Gaston, Williams & Wigmore, Inc. Speaking of the Graton & Knight Manufacturing Company of Worcester, Mass., the Bulletin says:

"A large and completely equipped chemical laboratory was established by this company a number of years ago and has consistently availed itself of every scientific discovery tending to increase quality. A staff of chemists under a chemical authority on tanning is constantly at work. All raw material is tested and in addition much work of an experimental nature is done in tannage, currying and other processes.

"In 1902 the chemists produced a waterproof leather belting."

Recent American Patents

Copies of the Specifications of the Following Patents May Be Obtained from the Commissioner of Patents.
Washington, D. C.

1,327,861—GAS-PRODUCER. William Climie, Ayr, Scotland. Filed February 25, 1919. Serial No. 279,163. Five claims.

1. A gas producer comprising a casing, a fuel rake arranged therein, a device for imparting a traveling movement to said rake over the surface of the fuel, and toothed crushing rolls carried by the rake structure, said rolls tending to maintain the rake at the top surface of the fuel and to crush the crust thereof.

1,327,691—APPARATUS FOR SEPARATING OIL AND GAS DIRECT FROM WELLS. Albert M. Ballard, Drumright, Okla., assignor to Sun Co., Philadelphia, a corporation of New Jersey. Filed March 12, 1919. Serial No. 282,141. One claim.

In an oil and gas separator, the combination with a tank having a gas outlet arranged at a relatively high elevation and an oil outlet arranged at a relatively low elevation, of a float in the tank, an oil and gas inlet pipe opening into the tank, a valve controlling the gas outlet, connections between the float and the gas outlet valve adapted to close the latter as the level of the oil rises and lifts the float, a valve controlling the oil outlet, a rod extending vertically through the float along which the float is vertically guided, another vertically extending guide rod outside the float, and means on the float slidably engaging the second guide rod and thereby holding the float from rotating on the first guide rod.

1,327,906—APPARATUS FOR RECOVERING GASOLINE FROM NATURAL GASES. Andrew B. Cross, Denver. Filed March 5, 1918. Serial No. 220,502. One claim.

In an apparatus of the character described, a cylindrical receiver, a jacket surrounding the said receiver and spaced from the same, and caps on the ends of said jacket having packing boxes through which the ends of said receiver pass, a pipe on one end of the receiver adapted to connect with a gas supply, a pressure regulator, a pipe connecting the opposite end of the receiver with the inlet of said pressure regulator, a pipe connecting the outlet of the regulator with the jacket at one end thereof, an outlet pipe extending from the opposite end portion of the jacket, and a drain pipe extending from the receiver adjacent to its outlet end and connecting with the same tank.

1,326,917—WATERPROOF VARNISH. Ralph E. Dings and Lionel Schuster, New York, N. Y. Filed November 22, 1918. Serial No. 263,676. Four claims.

4. A varnish suitable as a substitute for liquid shellac, comprising a mixed solution composed substantially of 200 pounds of Manila gum to 40 gallons of alcohol, with 100 ounces of carnauba wax to four gallons of spirits of turpentine.

1,327,862—SULFITE-WASTE-LIQUOR PREPARATION AND PROCESS OF MAKING THE SAME. Frank E. Coombs, San Francisco, Cal. Filed September 12, 1919. Serial No. 323,390. Five claims.

1. As a new material sulfite liquor having its organic constituents reduced.

1,328,047—PROCESS FOR THE EXTRACTION OF FATTY AND OILY MATTERS FROM WET SLUDGES. Leo D. Jones, Philadelphia, Pa., assignor to the Sharpless Specialty Co., West Chester, Pa., a corporation of Pennsylvania. Filed December 11, 1918. Serial No. 266,299. Five claims.

1. In the extraction of fatty, oily and like matters from wet sludge, the process which consists in treating said sludge with means for dissolving the matter to be extracted and floating the undissolved material on the aqueous solution, centrifugating the product so as to separate the solution of said matter from the aqueous solution and from the undissolved matter, and floating off said undissolved material.

1,328,051—MERCURY-COOLING SYSTEM. Thomas Midgley, Jr., Dayton, O., assignor to the Dayton Engi-

neering Laboratories Co., a corporation of Ohio. Filed January 12, 1918. Serial No. 211,694. Nine claims.

1. In a device of the character described, the combination with an element to be cooled provided with a cooling chamber; of a fluid-cooling medium in the chamber; and means located in the chamber providing for the passage of the fluid-cooling medium throughout the entire length of the chamber.

1,328,096—APPARATUS FOR EXTRACTING LYE FROM WOOD-ASHES. William P. D. Moross and John C. Costello, Chattanooga, Tenn. Filed August 2, 1917. Serial No. 184,107. Two claims.

1. Apparatus for leaching wood ashes, comprising a tray or receptacle to receive the ashes, means for supplying water to the ashes within the receptacle, a closure for the top of the receptacle, serving as a deflector for the material agitated within the receptacle, means for introducing steam in a series of jets into the receptacle to stir or agitate the ashes and subject them to the heating and dissolving action of the steam, and means for withdrawing the liquor which drains to the bottom of the receptacle.

2. Apparatus for leaching wood ashes, comprising a tray or receptacle to receive the ashes, said tray having a depending trough or gutter and the bottom sloping from the sides thereof, a cover or lid which may be opened or closed and when closed serving as a deflector for the material agitated within the receptacle, a steam conduit extending longitudinally above said gutter and provided with a plurality of openings for the escape of steam, a drain or trap connected to said trough, and a conduit connected to said drain.

1,328,082—PROCESS FOR THE PRODUCTION OF SYNTHETIC AMMONIA FROM THE AIR OR NITROGEN. Robert F. Gardiner, Clarendon, Va. Filed January 13, 1919. Serial No. 270,969. One claim. (Filed under the act of March 3, 1883, 22 Stat. L., 625.)

The process of producing synthetic ammonia consisting in bringing air into contact with an alkaline solution containing a metal from which nascent hydrogen is being evolved.

1,326,947—PROCESS OF MAKING HEXANITRODIPHENYLAMINE. John Marshall, Swarthmore, Pa., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del., a corporation of Delaware. Filed March 20, 1919. Serial No. 283,843. Thirteen claims.

9. The process which comprises treating 2,4 dinitrodiphenylamine with mixed nitric and sulfuric acids under conditions so regulated as to form 2,4,2',4'-tetranitrodiphenylamine, and then nitrating the tetranitrodiphenylamine at an elevated temperature with mixed nitric and sulfuric acids to form 2,4,6,2',4',6'-hexanitrodiphenylamine, the mixed acids contain in the first nitration 30 per cent. nitric acid and in the second nitration 20 per cent. nitric acid.

1,326,973—PROCESS FOR THE PREPARATION OF PYROCATECHIN ALDEHYDE. Ludwig Schmidt, Munich, Germany. Filed March 31, 1917. Serial No. 159,035. Two claims.

1. A process for the preparation of pyrocatechin aldehyde consisting in treating piperonal with thionylchloride and gaseous chlorine, and then saponifying the dichloropiperonylchloride thus formed with water, essentially as described.

1,327,105—PROCESS OF THE PRODUCTION OF TANNING EXTRACT FROM WASTE SULFITE LYE. Hans Brun Landmark, Drammen, Norway. Filed April 23, 1915. Serial No. 23,518. Three claims.

3. A process for the production of tanning extract from waste sulfite lye, characterized by evaporating waste sulfite lye to a concentration of about 16 to 18 degrees Baume; adding to the concentrated solution about 18 grams of carbonate of sodium for each liter of the amount of lye before concentration; separating the liquid from the precipitate thus obtained; and adding to said liquid a quantity of oxalic acid sufficient to precipitate the cal-

cium still remaining in solution; separating the liquid from the precipitate thus obtained and adding a sufficient quantity of formic acid to decompose any saccharate that may be present; and concentrating the solution thus obtained to about 27.5 degrees Baume.

1,326,159—PROCESS OF REGENERATING VEGETABLE CARBONS. Andrew Adams and Samuel Stodole Peck, Honolulu, Hawaii. Filed July 16, 1917.

1. The process of regenerating vegetable decolorizing carbons used in purifying saccharine solution which comprises fermenting such carbon, heating the fermented material in the presence of a solution containing an electrolyte to remove gummy matters and washing.

1,326,161—DRYING AND CARBONIZING MACHINE. Thomas Allsop and Walter W. Sibson, Philadelphia, Pa., assignors to the Philadelphia Drying Machine Co., Philadelphia, Pa., a corporation of Pennsylvania. Filed February 19, 1919.

5. A machine of the class described, the combination of an inclosure subdivided into a series of separate, independent treating compartments, wherein different conditions are required; and conveyor means passing through each compartment; the conveyor means of two successive compartments being adapted to transfer the materials from the one to the other, outside the confines of said inclosure, without relative modifying influence between the compartments.

1,326,210—PROCESS FOR THE MANUFACTURE OF A COLLOIDAL SOLUTION NEUTRAL TO THE TASTE FROM CASEIN AND VEGETABLE ALBUMEN, INCLUDING GLUTEN. Max Monhaupt, Altona-Ottensen, Germany, assignor to Naamlooze Vennootschap Anton Jurgens Verenigde Fabriken, Oss, Netherlands. Filed March 25, 1918.

4. A process for the manufacture of a colloidal solution from casein, such product being neutral to the taste, which consists in treating the casein with magnesia, the quantity of magnesia not required for neutralizing the acid reaction of the casein not exceeding $1\frac{1}{2}$ per cent. by weight of the casein.

1,326,248—PROCESS FOR THE PRODUCTION OF SYNTHETIC CAMPHOR. Roland L. Andreau, Wilmington, Del., assignor to E. I. du Pont de Nemours & Co., Wilmington, Del., a corporation of Delaware. Filed February 27, 1917.

1. The process of producing camphor from isoborneol by oxidation, which comprises heating isoborneol to a temperature of from about 75 to 86 degrees C. in the presence of nitric acid which is substantially free from substances capable of inducing a vigorous oxidation of the isoborneol by nitric acid at a temperature of 40 degrees C., and then lowering the temperature of the heated mass materially below 75 degrees C. after the reaction is well started.

1,326,267—CONDENSER FOR NITRIC-ACID VAPORS. Arthur Hough, New York, N. Y. Filed January 30, 1919.

A condenser for nitric acid vapor, comprising a casing built up of flanged sections, such sections being adapted to be bolted together to form a continuous upright device, the sections being also provided, at their meeting places, on opposite ends, with meeting arcuate recesses, a plurality of pipes each oppositely bent at points near both ends thereof, and extending through the openings in the casing formed by the meeting of said arcuate recesses, said pipes thereby forming a continuous passage for the nitric acid and its vapor, which passage is free from joints inside of said casing, an inlet and an outlet for cooling fluid located at the top and bottom of said casing, and baffles in said casing provided with apertures in staggered relation, whereby the cooling fluid is forced to flow in tortuous path through said casing.

1,326,276—COMMUNED EDIBLE FAT FOR SHORTENING PURPOSES AND METHOD OF MAKING THE SAME. Henry A. Kohman, Truman M. Gorfrey and Lauren H. Ashe, Pittsburgh, Pa., assignors to Ward Baking Co., New York, N. Y., a corporation of New York. Filed March 9, 1916.

2. The method of producing a hard fat for shortening purposes in a sufficiently fine state of subdivision to permit of homogeneous incorporation with the constituents of the material to be shortened, which comprises atomizing or spraying the fat at a temperature above its melting point into a suitable cooling chamber, and suitably regulating the spraying or atomizing to cause the deposition of the fat in the chamber in the form of a fine powder, whereby a minimum amount of the fat is required for shortening; substantially as described.

1,326,310—PROCESS OF GRANULATING CYANAMID CONTAINING FREE LIME. Victor Thrane, Christiania, Norway. Filed January 16, 1917. 641. Five claims.

1. Process of granulating cyanamid comprising the steps of feeding cyanamid containing free lime together with some water onto a moving surface, pressing the mixture thereby accelerating the reaction between the lime particles and water, pressing the mass after reaction has taken place, drying the product on the moving surface and breaking it up into granules of suitable size.

1,326,362—MECHANISM FOR APPLYING DRY COLOR TO ASBESTOS CEMENT SHEETS. Richard V. Mattison, Jr., Upper Dublin township, Montgomery county, Pa. Filed February 12, 1919.

1. In a device of the class described, the combination of a color reservoir; an aperture in the base thereof; a grooved cylinder rotating in said aperture; a rotary color brush rotating below said grooved cylinder; means for carrying surfaces to be colored in contact with said rotary brush; and means for regulating the speed with which the grooved cylinder rotates.

3. In mechanism for applying dry color to sheet material, the combination of rotary color brushes rotating in opposite directions with different surface speeds, means for carrying the sheet material past said brushes in succession so that it may move in the same direction as the more rapidly moving brush surface, and means for supplying dry coloring matter to be brushed upon the sheet material by said brushes in succession.

1,326,367—DYE AND PROCESS OF DYEING. Julius A. Nieuwland, Notre Dame, Ind. Filed December 3, 1917.

The herein described method of preparing a dye bath, which consists in reacting with a mercuric salt upon a solution of p-phenylene diamine at a temperature above normal.

The herein described method of dyeing fabrics, which consists in subjecting the fabric to the successive action of solutions containing respectively a mercuric salt and p-phenylene diamine.

1,312,258—ELECTRODE. Jesse C. King, Montreal, Quebec, Canada. Filed October 9, 1917. Serial No. 195,576. One claim.

1. An electrode comprising a carbon core having a roughened surface, and a coating of magnesite mixed with a carbonaceous binding material bonded or baked on the roughened surface.

1,312,293—TREATMENT OF WASTE SULFITE LIQUORS. Oswin W. Wilcox, Dover, N. J. Filed September 8, 1915. Serial No. 49,628. Renewed December 14, 1918. Serial No. 266,842. Three claims.

1. In the fermentation of waste sulfite liquors and the recovery by distillation of the resulting alcohol, the method of promoting the economic efficiency of the operation, which comprises supplying the fermented liquor to the still, during the transit of the fermented liquor to the still circulating said fermented liquor into heat-interchanging relation to the hot raw liquor from the digester and the hot spent liquor from the still, thereby preheating the fermented liquor so that it will enter the still at a temperature approximating the temperature of distillation, and supplying to the fermenting vats the cooled hot raw liquor; substantially as described.

1,327,197—MATERIAL TREATED WITH CELLULOSE DERIVATIVES. Joseph J. Byers, Brookline, Mass., assignor to Products Syndicate, Inc., Boston, Mass., a corporation of Massachusetts. Filed January 10, 1917. Serial No. 141,664. Ten claims.

6. As a new article of manufacture, a water-repellant fibrous material impregnated throughout with cement

containing a cellulose derivative and non-oxidizing oil, and consisting of initially united fibers charged with said cement and incased with the same.

10. As a new article of manufacture, leather or other fibrous material, which has been dried and then impregnated throughout with a cement which includes soluble nitro-cellulose and a non-oxidizing oil.

1,327,260—DYESTUFFS AND PROCESS OF MAKING SAME. Alvin S. Wheeler, Chapel Hill, N. C. Filed December 9, 1918. Serial No. 265,988. Thirteen claims.

1. The process of preparing dyestuffs which comprises dissolving a hydroxynaphthaquinone having less than three hydroxyl groups in a solvent, treating the solution with a halogen in excess, separating the halogenated product, and forming a salt thereof, substantially as described.

1,327,394—BLEACHING COMPOSITION—Richard B. Kadish and Theodore W. Buscher, Chicago, Ill., assignors to The Kadish Manufacturing Co., Chicago, Ill., a corporation of South Dakota. Filed December 11, 1917. Serial No. 206,589. Ten Claims.

1. The chemical composition made by the intermingling of a fluorid, a hydroxid and an acid sulfate of an alkali metal while in a nearly dry state.

1,327,396—PROCESS FOR PREPARING CATALYTIC AGENT FOR HYDROGENATING HARD OILS. Kanetsuke Kimura, Kobe, Japan. Filed August 1, 1917. Serial No. 183,982. One claim.

The process of preparing a nickel catalytic agent for hydrogenating oils, consisting in making powdered nickel nitrate with powdered pumice, charging the mixture into a vessel of a material which effects no catalytic action with such mixture, heating said vessel and its contents by heating means applied exteriorly of said vessel, agitating the contents of the vessel, and subjecting the contents of the vessel to the action of the vapor of ammonium chlorid.

1,326,851—PROCESS OF TREATING HYDROCARBONS. Walter M. Cross, Kansas City, Mo., assignor, by mesne assignments, to Gasoline Products Co., Inc., a corporation of New York. Filed June 1, 1915.

The process of manufacturing gasoline from heavier hydrocarbons such as residuum and the like, which comprises subjecting the hydrocarbons while substantially all in the vapor phase to a superheating, and preventing the deposit of carbon in the apparatus by injecting into the heated vapor a quantity of air less than sufficient to cause any complete combustion of the carbon in the apparatus.

1,326,384—PROCESS FOR THE EXTRACTION OF ALUMINA FROM CLAY. Harry G. Waldman, Montreal, Quebec, Can. Filed February 6, 1918.

A process for separating alumina from clay, which consists in first rendering the alumina of clay soluble, and then dissolving the alumina in the presence of sulfurous anhydrid.

1,326,432—PROCESS AND APPARATUS FOR THE RECOVERY OF ETHER AND ALCOHOL VAPORS CONTAINED IN THE AIR OF FACTORIES. Emile Augustin Barbet, Paris, France. Filed October 4, 1916.

A process for the recovery of ether and alcohol vapors contained in the air of factories, such as gunpowder works, artificial silk works, etc., which consists in absorbing the said vapors in dilute sulfuric acid, distilling the acid thus charged with ether and alcohol, separating the distilled vapors of ether and alcohol from the acid, condensing the separated vapors of ether and alcohol, slightly concentrating the residual acid, cooling the concentrated acid, returning the cooled acid for absorption of fresh vapors of ether and alcohol, and regulating the degree of dilution of the absorbing acid for the purpose of varying at will the relative proportions of the recovered ether and alcohol.

1,326,442—CYANAMID OVEN. George E. Cox, Niagara Falls, N. Y., assignor to American Cyanamid Co., New York, N. Y., a corporation of Maine. Filed July 21, 1919.

In a cyanamid oven provided with a refractory lining and a resistor the combination of a combustible tube surrounding said resistor; a plurality of supporting non-combustible surfaces separated by interstices and in close proximity to said refractory lining; a substantially smooth combustible sheet material resting against said supporting surfaces; means to introduce nitrogen into said oven; and means to convey the introduced nitrogen to said tube, substantially as described.

1,326,463—PROCESS OF LEACHING COPPER ORES. John J. Nelson, Los Angeles, Cal., assignor of one-fourth to Oluf H. Westergaard and one-fourth to Bryant Mathews, Los Angeles, Cal. Filed March 26, 1918.

A process of extracting copper from ores containing copper sulfate, which comprises leaching the ore with a solution containing sodium bisulfate and sodium chlorid, filtering the gangue from the solution after the ore has been subjected to the action of the solution for some time, passing said solution into a precipitating tank containing iron in a finely divided condition, adding sodium chlorid to the solution in the precipitating tank, and removing the precipitate from said tank.

Mainly About Companies

Atlas Powder Company

The Atlas Powder Co. reports for the year ended December 31, 1919, a surplus after dividends of \$519,801 compared with \$671,589 in the previous year. According to the annual report just issued the financial position of the company is the strongest in its history. All bank loans and contract advances made necessary for the volume of business transacted prior to 1919 have been entirely liquidated.

Following is the comparative income account for 1919 and 1918:

	1919.	1918.
Gross sales.....	\$19,107,340	\$35,766,619
Expenses, etc.....	17,429,043	33,583,624
Net operating profit.....	1,678,297	2,182,995
Net income.....	1,660,089	2,262,293
Surplus after dividends.....	519,801	671,589
Previous surplus.....	4,769,190	4,097,601
Total surplus.....	5,288,991	4,769,190

Mathieson Alkali Works

E. M. Allen, recently of Chicago, Ill., has been elected president of the Mathieson Alkali Works, Inc., taking the place of E. E. Arnold, resigned.

F. B. Richards, formerly assistant treasurer, has been made secretary and treasurer, taking the place of J. R. Gladding, resigned.

All of the operating departments of the company have been put under the charge of Max Mauran, vice-president, who will have Col. Charles A. Vaughn as manager of the Niagara Falls Works and J. H. McMahon as manager of the Saltville, Va., Works. Extensive improvements now under way at both these plants will add materially to the company's capacity.

The general offices, now located at Providence, R. I., will be moved to New York March 1, 1920, the company having leased a large part of the tenth floor of the new building located at 25 West 43d street.

What changes the Mathieson company will make in its present selling arrangements no one has been able to learn from the company's officials.

Atmospheric Nitrogen Company

The General Chemical Co., 25 Broad Street, New York, and the Solvay Process Co., of Syracuse, N. Y., have organized the Atmospheric Nitrogen Corporation for the development of nitrogen fixation, with \$5,000,000 capital. According to R. L. Pierce, president of the Solvay Process Co., it is contemplated to erect a development plant at Syracuse, N. Y., at an approximate cost of \$1,000,000. The following officers have been elected: E. L. Pierce, president; A. W. Hudson, treasurer; Ernest Jones, secretary; directors—Mr. Pierce, H. H. S. Handy, E. L. Miller.

New Incorporations

A. B. C. Soap Corporation of Manhattan has been incorporated with a capital of \$250,000 by A. Day, J. P. Booth, T. A. Sherman, 100 Broadway.

Andrews Sabine Paint Corporation of Utica has been incorporated with a capital of \$50,000 by D. and A. A. Sabine, A. V. Andrews, Utica.

National Alcohol Company, Bronx, has been incorporated by H. L. Oxman, J. Karlin, S. B. Kaideen, 1200 Hoe avenue, Bronx.

Acetylene Gas Corporation of America has been incorporated under the laws of New York with a capital of \$500,000. Incorporators: W. B. Ragatz, A. W. Rowbotham, W. L. Braithwood, Plattsburg.

Astra Chemical Co., Bronx, has been incorporated by J. M. Cantwell, H. M. Caswell, I. Rosenblum, 600 West 187th street.

Langwald Chemical and Alcohol Company, Manhattan, has been incorporated by W. and A. M. Devorkind, J. Langer, 954 East 173d street.

United States Procaine Company, of Manhattan, drugs and chemicals, has been incorporated by M. and J. J. Nevin, M. Hirsch, 50 East 41st street.

Ivorart Mfg. Co., of Brooklyn, celluloid novelties, has been incorporated with a capital of \$100,000. Incorporators: C. and A. S. and H. Weil, 92 Morningside avenue.

Hasbrouck Corporation of Manhattan, drugs and chemicals, has been incorporated with a capital of \$100,000. Incorporators: H. C. Ford, J. B. Goldsborough, J. Brouchaud, 290 Broadway.

Apex Color Works, Manhattan, chemicals and paints, have been incorporated with a capital of \$50,000. Incorporators: A. and M. and L. Leideker, 1328 46th street, Brooklyn.

Norwegian Nitrogen Products Company of Manhattan has been incorporated under the laws of this State by W. H. Campbell, H. M. Simon, A. W. Varian, 50 Pine street.

Superior Carbon Products of Poughkeepsie has been incorporated, with a capital of \$150,000, by C. Hastings, M. E. Northrop, H. B. Vosburg, Poughkeepsie.

The development of asbestos properties in South Carolina is proposed by the Palmetto Asbestos Company of Columbia, which has been incorporated by W. C. McGowan and T. C. Cross. This company is capitalized at \$250,000.

Cavanagh Wholesale Drug Co., of Manhattan, has been incorporated by M. A. and T. Cavanagh, E. McDonnell, 262 Alexander avenue, Bronx.

Jean Valee et Cie., perfumeries and chemicals, has been incorporated by J. M. Pendas, C. E. McCormick, E. Weisner, 337 East 85th street.

The Typco Products Corp., soaps, washing fluids, etc., has been incorporated in Delaware with a capital of \$2,500,000. Incorporators: T. L. Ernst, L. S. Dumensil, J. Meehan, all of New York.

Pennsylvania Food Digester Co., chemicals, drugs, etc., has been incorporated in Delaware with a capital of \$50,000. Incorporators: Leonard Shadduck, W. R. Hayden, Archie B. Richardson, all of Brooklyn, N. Y.

Lambert Chemical Co. has been incorporated in Delaware with a capital of \$30,000. Incorporators: George V. Reilly, Robert K. Thistle, Harry C. Hand, New York.

Stamford Dye Wood Company, tanning extracts and dyes, has been incorporated in Delaware with a capital of \$300,000. Incorporators: E. Kraychic, H. G. Leise, A. Skillman, all of New York.

Gibson-Snow Co., Inc., of Albany, N. Y., wholesale druggists, has increased its capitalization from \$1,200,000 to \$2,700,000.

Parfumerie Vernay, manufacturers of soaps, etc., has been incorporated under the laws of Delaware with a capital of \$100,000.

Star Bottling Co., bottlers of soft drinks, etc., has been incorporated under the laws of Delaware with a capital of \$50,000. Incorporators: William O. Orre, Ralph Sam, H. Earl Sorber, Johnstown, Pa.

Oceanus Laboratories of Rockaway Park, chemists and druggists, has been incorporated by E. and L. M. Booker, R. Georgine, Rockaway Park.

New Castle Refractories Co., clay products, has been formed under the laws of Delaware with a capital of \$50,000.

Albany Chemical Company, of Albany, N. Y., has increased its capitalization to 20,000 shares preferred stock, \$50 each; 5,000 shares common stock, no par value; active capital from \$500,000 to \$1,500,000.

George S. Coyne Chemical Company, manufacturers of dyestuffs, etc., has been incorporated in Delaware with a capital of \$100,000.

Dearborn Color & Chemical Co. of Manhattan has been incorporated with a capital of \$25,000 by J. C. Millard, C. J. Colville, F. Pye, 969 Forest avenue.

Federal Composition & Paint Company of Manhattan has been incorporated with a capital of \$500,000 by H. P. Molloy, M. J. France, F. X. Hennessy, 25 Broad street.

York Products Corporation of Manhattan, drugs and chemicals, has been incorporated with a capital of \$25,000 by S. F. Stern, A. Lowenstein, L. C. Tarasch, 5010 12th avenue, Brooklyn.

Plant Construction

According to a report from Montreal the National Electro-Products, Ltd., with a capital of \$5,000,000 financed by Montreal and Toronto interests, will establish a chain of plants across Canada, as the result of the successful invention by a Canadian chemical engineer, A. J. MacDougall, for the manufacture of oxygen of 100 per cent. purity, a degree which has never yet been approached either on this continent or in Europe. The company is also contemplating establishing plants in the United States.

The Glidden Paint and Varnish Company of Cleveland will operate the plant of the Yaryan Rosin and Turpentine Company for the next year for the stockholders of that company and this concern also has an option to buy in the property at the expiration of that time at a figure close to \$2,000,000 if it so desires, according to a report from Savannah.

Superior Glass Products Co., Columbus, Ohio, has acquired a three-acre site in Huntington, W. Va., on which it intends to establish a plant. It will build a bending room, install machinery and manufacture glass for lenses, microscope slides, etc. W. D. Fulton is president and general manager.

Plans have been prepared for the \$1,000,000 addition recently announced for the Libby-Owens Sheet Glass Co., at Clarksburg, W. Va. These plans call for the construction of a steel and concrete building of two stories, 550 feet long and 450 feet wide, the contractor being the George A. Fuller Co., of New York. The structure is to be fitted up for the manufacture of every kind of glass.

A plant for the manufacture of varnish costing \$100,000 is to be erected at Houston, Tex., by the Glidden Company.

Trade Notes

The Shawinigan Water & Power Co. of Montreal, Quebec, has announced the formation of a new subsidiary, the Shawinigan Products Corporation, with offices in the Mohawk Building, 160 Fifth avenue, New York. This company will handle the United States and export sales of Canadian carbide, acetic acid, acetaldehyde, paraldehyde, acetic anhydride and other chemical products now in process of development, all manufactured by its associated companies, the Canada Carbide Co. and the Canadian Electric Products Co., both of Shawinigan Falls, Quebec. This move will centralize in one organization the sales of products now being handled by the Canada Carbide Sales Co., as to furnace products, which company will cease to be active, and the C. B. Peters Co., Inc., 15 Maiden Lane, New York, as to chemical products, who will continue with us actively as sales associates.

The National Aniline & Chemical Company, Inc., announces that it has withdrawn from the jobbing of all goods not of its manufacture. Sales efforts will be confined to products produced in its own factories, such as dyestuffs, intermediates, food colors, coal tar drugs and related products. This step is taken for the purpose of accomplishing effective concentration on its dyestuffs and allied organic products business.

J. Kaufmann, Johnston and Jay Streets, Brooklyn, has been appointed New York representative of the American Safetee Soap Corporation of Virginia, capital \$1,000,000.

Finished dye in crystal form to the extent of 350,000 pounds will be the monthly production of an additional manufacturing unit which the Consumers' Dyewood Products Corporation will install in its plant at Choctaw Point, near Mobile, Ala. Contracts have been awarded for machinery, and installation will be completed March 31.

Plans are under way for the erection of a \$15,000 plant in Weehawken, N. J., for the European Color & Chemical Co. of Hoboken.

The offices of Marden, Orth & Hastings were removed on January 12 from 225 Purchase street to 111-113 Lincoln street. This removal marks the passing of one of the old landmarks of Boston. Since 1837 the offices of the firm were at Purchase street. A few years ago the management was transferred to New York. The warehouses in Purchase street are still being retained.

The National Aniline & Chemical Co., Inc., has recently issued an attractive color card, showing samples of paper dyed with those of their products, which are especially applicable to paper. Forty-two shades are shown. General information as to the use of these colors is given.

The National Aniline & Chemical Company, Inc., announces the production of a new medicinal base known as methylene blue, medicinal, U. S. P.

Fire which caused damage estimated at \$125,000 occurred on February 12 at the Cleveland plant of the United States Gypsum Company.

Judge Hand has appointed Philip D. Elliott ancillary receiver for the Essex Chemical Works, Inc., Belleville, N. J.

The forty-fifth annual meeting of the National Wholesale Druggists' Association will be held at the Hotel Gibson, Cincinnati, Ohio, during the week beginning October 25, 1920. This early announcement is made in order that members may set apart the week of October 25 for this year's convention. Details of hotel accommodations, rates and routes will be made at a later date by the appropriate committees having charge of these matters.

C. Guthenburg, 14 Ferry street, has been appointed New York representative of the American Glue Company, a Massachusetts corporation.

W. A. Bridgeman, formerly associated with the Teagle Company of Cleveland, is now general manager of the Wilbur White Chemical Company of Oswego, N. Y.

C. W. Campbell, 11 Cliff street, has been appointed New York representative of Uniform Chemical Products, a New Jersey corporation, with a capitalization of \$150,000.

Julian W. Lyon, drug and essential oil broker, now located at 99-101 Beekman street, has bought the building at 35 Fulton street for occupancy about May 1.

Miss M. E. McGovern, formerly manager of the chemical department of Charles A. Anderson & Co., is now general manager of the Bur-Mac Corporation, 15 Park Row, dealers in industrial chemicals.

Like several other large houses that have found it impossible to secure sufficient satisfactory office space in the lower downtown section Laidlaw, Kelley & Co., Inc., have decided to move uptown. They have acquired the 21-year leasehold at the southwest corner of Thompson and Grand streets, a seven-story and basement building, where they will consolidate their various departments now located in several buildings downtown, and where they will have increased warehouse facilities to better serve the requirements of their customers for prompt deliveries from New York stock.

Robert H. de Greeff, president of R. W. Greeff & Co., Inc., 78 Front street, and Gerard M. Loly, associated with the same firm, have just returned from an extended visit to England and the Continent, where they have been investigating conditions in the chemical industry and trade conditions in general.

The Essex Aniline Works, Inc., have removed their offices, formerly at 39 Oliver street, Boston, Mass., to 88 Broad street.

The Columbia Chemical Company has been granted a permit to erect a \$30,000 plant in Roanoke, Va.

The Colonial Chemical Company is spending upwards of \$600,000 on a plant being erected on the corner of Broadway and Johnston street, Minneapolis, Minn. The principal product will be sodium sulphate. The plant will have a capacity of 100,000 tons a day. Officers of the company are: J. W. Smith, president; J. W. Black, vice-president, and C. B. Piper, treasurer.

The Chemical Fuel Company, Louisville, Ky., plans to manufacture a gasoline substitute in the new plant which it is completing in that city. The new fuel will be a vegetable product.

The plant of the Forest Products Chemical Company will be further extended in the near future, according to the president, W. H. Matthews.

The Ki-Moid Chemical Co., of Bloomfield, N. J., has been incorporated. The concern will manufacture pharmaceutical and other preparations.

The recently organized Thatcher Process Corporation of Syracuse, N. Y., has secured quarters in Tracy street, same city, and will begin at once equipping a plant for electrochemical operations, specializing in the manufacture of anthraquinone.

The Calco Chemical Company has closed its dye plant at Burlington, N. J. The factory is being dismantled and the equipment being sent to Bound Brook. E. B. Taylor, superintendent of the Burlington plant, has been appointed assistant superintendent of the intermediate department.

The Uricol Chemical Company has been incorporated in Boston with an authorized capital of \$150,000.

We are advised that the recent announcement to the effect that the Union Casein Company and the National Waste Company, both of Philadelphia, had purchased the plant of Clark Bros. Lamp Company, of Trenton, N. J., is unfounded, and that neither the Union nor National concerns are interested in the property named.

The American Crosote Works, whose plant is located in Ann Arindel County, Md., near Baltimore, plans extensions.

The Sherwin-Williams Company have moved their general sales and executive departments from 116 West 32d Street to larger quarters at 115 Broadway, New York City.

The Northwestern Turpentine Company is to extract rosin by a new process from a tract of Douglas fir timber of 160 acres, near Disston, Oregon.

The Marentay Varnish Company has been organized at Detroit, Mich., with \$150,000 capital, to manufacture and sell varnishes, chemicals, and paints.

New Publications

The United States Geological Survey, Department of the Interior, Washington, D. C., now has available for distribution its annual statement of the production, exports and imports of sulphur and pyrites in the United States in 1918. The sulphur produced in the United States in that year was 1,353,525 tons.

The Door Company, New York City, has issued a handsome bulletin describing its new Westport mill located at Westport, Conn. The mill is equipped for research work and the testing of various metallurgical chemical and industrial processes on a semi-commercial scale. Copies of this bulletin may be obtained on application to the company's office 101 Park avenue, New York City.

The Bureau of Standards has issued "Circular No. 85, Recommended Specification for Basic Sulphate White Lead, Dry and Paste." This specification is based upon the recommendations of the Interdepartmental Committee on Paint Specification Standardization, recommendations which after being approved by the committee were submitted to members of the paint trade for suggestions in draft form. Interested parties may obtain copies from the Bureau of Standards.

The Third Annual Report of the United States Tariff Commission has been issued. The commission has also issued a report dealing with "The Acids of Paragraph 1 and Related Materials Provided for in the Tariff Act of 1913."

The Bureau of Plant Industry, United States Department of Agriculture, has issued a bulletin dealing with peat, under the title "Quality and Value of Important Types of Peat Material." This bulletin written by A. P. Dachnowski, bears the subtitle "a classification of peat based upon its botanical composition and physical and chemical characteristics."

Bulletin No. 803, United States Department of Agriculture, is entitled "A Chemical Study of the Ripening and Picking of California Olives." The authors are Mr. R. W. Hiltz, chief of Western Food and Drug Inspection District, and Mr. R. S. Hollingshead, junior chemist, San Francisco Station.

Mainly About Chemists

Mr. C. Luther Masser has resigned as instructor of chemistry at the Philadelphia Textile School, Philadelphia, Pa., to accept a position as supervising chemist with the New York Quinine and Chemical Works, Brooklyn, N. Y.

Capt. W. E. Brophy, late of the Chemical Warfare Service, has joined the staff of Arthur D. Little, Inc., Cambridge, Mass.

Mr. H. P. Zeller, formerly connected with the By-Product Coke Plant of the Toledo Furnace Co., Toledo, Ohio, is now vice-president and general manager of the Donner Union Coke Corporation, Buffalo, N. Y.

Dr. Arthur R. Hitch, formerly connected with the Ashland Iron and Mining Company, Ashland, Ky., is now attached to the staff of the E. I. du Pont de Nemours & Co., Wilmington, Del.

Mr. Lawrence R. Taylor has been appointed director of scientific work for the French Lick Springs Hotel Company, French Lick, Ind.

Mr. George D. McLaughlin has resigned his position as chief chemist of Kullman Salz & Co., San Francisco, Cal., to do research work under Dr. Martin H. Fischer, at the University of Cincinnati, Cincinnati, Ohio.

Colonel G. A. Burrell, formerly Chief of the Chemical Warfare Service, U. S. Army, has organized the Burrell Technical Supply Company with offices in the Chamber of Commerce Building, Pittsburgh, Pa. Colonel Burrell is president of the company, the other officers being J. T. Ryan, vice-president; G. H. Deike, treasurer, and G. C. Nelms, secretary. The personnel also includes G. H. Burrell, E. H. Kellogg and R. P. Mase, formerly Chemical Warfare Service Men. The company will conduct a general laboratory and technical supply business and will issue catalogs in the very near future. One of the first catalogs to be issued will be devoted entirely to gas analysis apparatus and will describe and illustrate the various apparatus which Colonel Burrell has developed in his extensive work on gas investigations. Work on the new building in Pittsburgh, which will give this company greatly added facilities, is being rushed to completion.

Secretary Walter Mueller, of the Manufacturing Perfumers Association, has issued a bulletin to the members of the association in which it is pointed out that the Internal Revenue Bureau has approved of four materials which may be used in lieu of tartar emetic in making hair tonics, and such materials nonpotable. The four materials are quinine sulphate, cinchonidine sulphate, resorcin and salicylic acid.

Ohio Columbus Barber, founder of the Diamond Match Company, died in Akron, Ohio, February 4.

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The Place of the University in Industry

UNIVERSITIES have a new mission these days which was never even dreamed of when they were more like classic fanes than they are at present. The war showed the college man and the college professor were much more practical than the industrial entrepreneurs realized.

There was a certain college professor who was an expert in the literary pursuits of English. As a recreation from teaching he whittled propellers for airships and steam vessels. The high cost of living caused him to wonder how he might better cleave the waves of economic stress for his own family craft. He was showing some of his propeller designs to a friend and that was the last of him in the groves of Academe. A shipyard took him over and he has left his text-books forever. He is now the superintendent of one of the yards of a shipbuilding corporation, and even with his academic training, if somebody asked him what the Latin word for boat was he would probably have to think hard before he could recall it.

The manufacturing corporations have been for the last year or so depleting the university faculties. Both they and the educators as well have found that this would not do, for there must be hundreds more young men trained to direct the work of the big industries. So there has been a compromise arranged in some quarters under which the university or the institute of technology takes over experimental and research work for the manufacturer and conducts it in its own laboratory. The work is done by professors who, otherwise, might have been withdrawn from teaching entirely.

William H. Nichols, head of the General Chemical Company, recently remarked before a gathering of New York University alumni: "We are killing the goose that lays the golden egg." This is the whole story in a nutshell. One man trains a hundred. Take him away and he can only do one man's work.

One of the institutions where this plan has worked out with special success is the College of Engineering of New York University. Several of its best known faculty members, among them the English instructor, who was also a genius in mathematical design, had been lost to the university before the new plan was put into operation.

There is a vast difference between the problems which are tackled by bright young man in denim blouses, as compared with those which engage the attention of youths in caps and gowns.

Most of the researches which have been undertaken in the College of Engineering are allied with the progress of manufacture and commerce. They cover a wide range. One of the ideas which has been worked out there in the last few months is the development of a non-corrosive metal, a substance which is of the highest importance in processes where powerful acids are employed. Industry is always looking for ways in which to get all that there is out of steam, for the driving of water into its vaporous state is a very costly proceeding. The scientists on University Heights, in co-operation with a leading manufacturer, have perfected a device for the superheating of steam which has proven a commercial success.

Crude petroleum is transported in large quantities by pipe line. Many thousands of dollars in research have been spent by companies in years past to devise means for forcing the crude oil through the pipes with the least expenditure of power. The experiments contemplated, these days, under the direction of Dean Snow and his assistants, undertaken for the purpose of determining the friction losses in the flow of oil in pipes, are therefore of prime importance.

Every time that the Hudson River is filled with floes of ice and the railroads are blocked by snow drifts, the old question of how to get coal into New York City is considered. This accounts for the development of the oil engines in the metropolis. Many owners of factories are supplanting their furnaces which burn coal with oil-burning devices. It is said one concern can save \$500 a month by so doing. The use of petroleum as a fuel cuts down transportation bills, and it would be possible, for that matter, to pump large quantities of the rock oil through pipes even to a greater extent than it is now done.

Some of the oil engines are so small and cheap and yet so adapted to many uses that the number of them in New York City is constantly increasing. Small ones are employed to run elevators and loft

buildings, while others of tremendous size, such as those that are being installed in the newest addition to Bellevue Hospital, are capable of generating great volumes of power.

In view of the interest in the new types of machinery, the university is installing apparatus for distinct investigations on oil-burning devices under boilers.

Connected with the main engineering building now being erected there will be a wing devoted especially to the testing of all kinds of house heating boilers, a field of investigation attracting attention by reason of the high cost of coal.

Manufacturers of such apparatus have been co-operating with the engineering faculty in the perfection of boilers. This work, upon which so much of efficiency and safety depends, will be expanded next autumn, when the facilities of the new structure are available.

One of the most interesting tests now being planned by the faculty experts is that of ventilating fans, used under the severe conditions of handling acid fumes from chemical laboratories. Several models are being set up in the university laboratories, and through many ingenious methods the corrosive effect on these fans is removing the vitiated air and determining the friction losses in the ducts will be observed.

In all mechanical operations the time and expense required in the sharpening of tools must be considered. Progress toward the reduction of such cost is shown in the development of a new course for studying cutting tool operations, which will soon be ready in the new curriculum of industrial engineering. Tests of metals for such purposes have already been conducted in the university laboratories.

Under the direction of Professor Collins P. Bliss and Hazen G. Tyler, two members of the faculty, who are in close touch with American industries, arrangements are being made for further co-operation along these lines.

"Although many large corporations maintain research laboratories of their own," said Professor Bliss yesterday, "they are finding it to their advantage to conduct some of their investigations under university auspices. Frequently companies turn over to us the entire charge of a problem in which they are interested. The co-operation between the university and industry goes far back into the history of the institution. In the course of time we shall have a still closer union between the laboratory and the factory, as many large firms are preparing to educate promising young men in their employ by having them spend part of their time at the plant and part of it in classes. Two men are being sent to us next autumn as 'specials' by a large industry as far away as Detroit for the purpose of getting a two-year training to fit them for

advanced positions already awaiting them. The interesting feature of this departure is that they are to be paid the same wages while with us as if they were working in the industry at home." Professor Bliss asked the head of the business how this could possibly pay. "Say, Bliss," said he with a merry twinkle his eye always has, "I'll get that back ten times over."

In educational and industrial circles the arrangement now being made for harmonizing the activities of both is regarded as one of the most progressive steps of the times.

The Canadian Paper Industry

THE Dominion Bureau of Statistics, Department of Trade and Commerce, Ottawa, has prepared a report covering the pulp and paper industry in Canada for the year 1918. The statistics are presented for each class by number of mills, as follows: Pulp mills, 37; paper mills, 31; pulp and paper mills, 26; or a total of 94 mills. The total capital invested in the industry was \$241,344,704.

The quantity and value of materials used in the manufacture of paper were as follows:

	Tons.	Value.
Ground wood pulp.....	679,395	\$14,215,895
Sulphite fiber	242,685	13,665,361
Sulphate fiber	35,587	2,260,443
Soda fiber	4,775	397,621
Other chemical fiber	2,419	219,654
Rags	20,138	1,412,367
Old or waste paper	47,350	1,320,338
All other paper stock	8,764	634,149
All other materials .....	....	3,423,508

Total cost of paper materials... \$37,549,336

The total value of paper manufactured in 1918 was \$76,700,913, of which \$46,230,814 was in newsprint. The total value of wood pulp manufactured for sale or for export was \$42,608,521.

Petroleum Refineries Overbuilt

FIGURES recently compiled by the Bureau of Mines, Department of the Interior, show that the petroleum refinery capacity of the United States is considerably overbuilt. At the present time the refineries have a total rated capacity over 50 per cent. in excess of the refinable oil supplies, which is likely to be near 80 per cent. when the refineries now under construction are completed.

The oil runs to the refineries of the United States for the year 1919 were 361,520,153 barrels of crude oil, or 990,466 barrels per day. In December, 1919, the refineries in operation had a daily capacity of 1,356,355 barrels per day, whereas the daily run of crude oil to the stills was 1,046,052 barrels, indicating that they are running at only 73 per cent. of their rated capacity. Refineries of an additional 174,210 barrels capacity per day were idle, while refineries totaling a capacity of 263,00 barrels daily were under construction.

It is evident that larger supplies of refinable crude oil are needed by the refineries which are

now in active competition in the purchasing of crude oil in the open market. This competition for oil to keep the refineries in full operation has doubtless been one of the influences in the recent advances of crude oil in the United States. Crude oil in the Mid-Continent field, which produces some two-thirds of the refinable oil in the country, has advanced from \$2.25 per barrel to \$3.50 per barrel in the last few months.

The Need for Managers

OVER-NIGHT or week-end educations in "memory training and business management" were criticised late in March by Dr. Hollis Godfrey, president of the Drexel Institute. Addressing the convention of the Technology Clubs Associated, he said courses in "business efficiency," etc., frequently advertised for quick and easy assimilation were "get-rich-quick" education.

"There are not enough freshmen in technical colleges now to make up for the shortage in executives," he declared. "Many industries also need foremen. One of the great needs of the day is for management education of the proper kind."

What the colleges of the country should do in the way of training technical men to be absorbed by the industries was definitely outlined today.

An outline and specification for such training, with authority to create a committee to put it into effect, were framed in the form of a resolution submitted to the convention by Dr. Godfrey.

The resolution was the outcome of deliberations by industrial groups into which the convention was divided yesterday. These took up the problems along the lines of public utilities, shoe and leather, paper, paint and varnish, rubber, railroads, cotton findings, textiles, machinery and metals and mining. The resolution provides:

"Each of the industrial groups represented in this movement for the writing of a joint specification by industry and the colleges shall appoint a committee, one of whose members shall act as a delegate to a central council.

"This council shall appoint a co-operating committee to act with the committee designated by the American Council of Education.

"These two committees shall act as a joint clearance committee to advance the drawing up of specifications as to the qualifications of college trained men and women needed by the several industries, disseminating both to the college and the industry the information as to quantity and a betterment of quality of the output of the colleges."

An English Dye Shortage

DYE consumers in England are showing decided anxiety over the prospect of a short supply. A committee representing all the dependent industries is now in Germany to buy such dyes as are

most required. Their present authorization is to buy up to \$10,000,000 worth. For several months past there has been a great deal of anxiety on the part of dye manufacturers as to the future of the British dye industry, owing to the fact that certain high-class dyes which are very much needed in the textile and other trades are not produced in Great Britain.

Consul C. S. Winans, at London, in a dispatch to the Department of Commerce, says that during the last year there has been considerable criticism by users of the range of dyes available either from British dye manufacturing work or from the supplies which have been imported from Germany in fulfillment of the terms of the treaty of peace. These criticisms arise from a fear that the British textile trade may be placed at a disadvantage in the markets of the world. It is claimed that 80 per cent. of the dyes now used in Great Britain are of home production, but the quality available is not sufficient for the needs of textile manufacturers, to say nothing of the high-class dyes.

The American Gas Association, of which George B. Cortelyou, of the Consolidated Gas Company, is president, gave out a statement yesterday saying that the various State utility commissions, the Bureau of Mines and the United States Geological Survey had been asked to co-operate with the gas company in obtaining sufficient gas oil for the manufacture of gas.

Several of the gas companies are already confronting an entire lack of oil, and other companies state that when their contracts with oil corporations expire it will not be possible to renew them.

Our Neglected Home Market

AND speaking of foreign trade, may we pause to remark, that disillusionment is beginning to affect many of our would-be importers and exporters? Since the signing of the armistice the way of the man with the newly acquired foreign business has been none too easy: there has been a very decided contraction of demand and the question of finance has become increasingly difficult. Countries which we had in the first flush of our appreciation of our opportunities in the foreign field, regarded as our best prospective customers, have developed a decided reluctance to buying outside their own borders, a reluctance which has been accentuated by the financial barriers raised by heavy discounts on their depreciated currencies.

In the export business which has been built up since the outbreak of war, we might almost say that a sifting out process is in progress: a process which is gradually eliminating by force of competition, the less firmly entrenched exporters. The business of the exporter for whose existence there is a real reason, is of course, not being affected.

That a certain contraction should occur in our

exports was after all inevitable. And the situation is not without its compensations. After all we have a fairly extensive home market. That home market is badly in need of commodities of all kinds. Granting that we can put our own house in order, the "makings" of a very considerable degree of commercial prosperity lie right at our door.

A Banker's Diagnosis of Our Troubles

SPEAKING in Chicago the other day on his way to the Orient, Frank A. Vanderlip, told the members of the City Club, that there were three things upon which real prosperity could be based, first, ample fresh capital, second, efficient labor, and third, a public appreciation of sound economic principles. Our present prosperity, he held, was unsound because taxation prevented us getting the first labor discontent partly eliminated and second and third, is still unfortunately only an ideal. The Government, according to Mr. Vanderlip, takes in taxes today, the surplus which formerly was used to provide capital for industry. Not only does it take this capital, but it continues to spend it in various unproductive ways, with a prodigality which only war time habits of economy could possibly justify.

Mr. Vanderlip's diagnosis of the industrial and financial situation is unquestionably sound: that almost anyone will agree. When it comes to suggesting remedies—well—that is a different matter! Mr. Vanderlip comes out for Governmental economy, and greater participation of labor in the management of industry.

Study of Labor Problem Needed

THE railroad strike, if it does nothing else should jar even the most imperturbable of us into a realization of seriousness of the labor situation in this country. Perhaps, in expressing the hope that will jar even the statesmen who claim to direct the affairs of this country, into a similar realization, we go too far. But the realization should not be left to any other agency outside ourselves:

"The buck" must not "be passed" any longer. Like the New York commuters who, when trains were deserted by striking railroad men, ran the trains themselves, every American manufacturer and business man must cooperate to seek some solution which, when put into effect, will enable American industry to function normally once again. There is no gainsaying the fact that today production in the United States is not more than sixty per cent. of normal. This fact alone would be serious enough in normal times but today it is doubly so.

So far as production is concerned, the solution of our difficulties, seems to hinge upon some method of persuading the workman to do a dollar's worth of work for a dollar's worth of pay. True as it

may be, that the laboring men of this country are dissatisfied, sometimes unreasonable, often tyrannical in their demands, and that their actions are in many cases based upon misconceptions fostered by unscrupulous agitators, after all we "face a condition not a theory," and it is the part of every American manufacturer, not to grow panic stricken, at the mention of the word "red" but to recognize that the situation calls for study and careful calculated action, action just as careful and scientific as the consideration of a new market or the production of a new invention. What that action should be it is hard to say but that it should be based upon study not hearsay there is no denying. Napoleon once said that the greatest mistake a general could make was to despise his opponent. Do not let us despise our opponents in this matter: they use science in fighting us. Let us do the same.

General Sibert's Retirement

WORD comes from Washington that Gen. Sibert, at his own request, has been placed on the retired list. The official reason for his retirement is that he could no longer "content himself with routine army life." Nations like princes are notoriously ungrateful in times of peace, to those who have served them and served them well, in times of war. General Sibert seems to have met the fate of many other capable and patriotic men before him; his opinions regarding the measures which should be taken to preserve the integrity of the Chemical Warfare Service, displeased the "powers that be" with the result that his position was made decidedly unpleasant.

Surely, however, General Sibert must console himself, in his apparent defeat, with the thought that his record of war service, is now a matter of history and that this record cannot be rendered one of less brilliant, by all the politicians who inhabit the District of Columbia.

Farm Labor Shortage

A SHORTAGE of farm labor which will be as acute as that of 1918 threatens to curtail food production on American farms, Secretary of Agriculture Meredith said in an appeal to business men and college students to spend their vacations working on farms, particularly as helpers in harvest fields.

The supply of farm labor is only 72 per cent. of normal, carefully compiled reports to the department indicate, compared with 84 per cent. last year. The fact that the present situation exists despite an increase of 15 to 25 per cent. in wages paid farm hands is regarded as highly important by Secretary Meredith. As a result more acreage will be put into grasses and other crops requiring a minimum of labor.

Science and the Glass Industry

Only within the last ten years have any advances along technical lines been made in the glass industry of the United States. A new interest is, today, however, being taken in scientific research and the future is very bright.

By C. H. Kerr

Research Manager, American Optical Company

GLASS making dates back to the earliest antiquity. Who made the first glass and the manner of its accomplishment is apparently a subject for perpetual debate but we have well authenticated records of the glass work of the early Egyptians. The Romans found wide use for glass in their well-

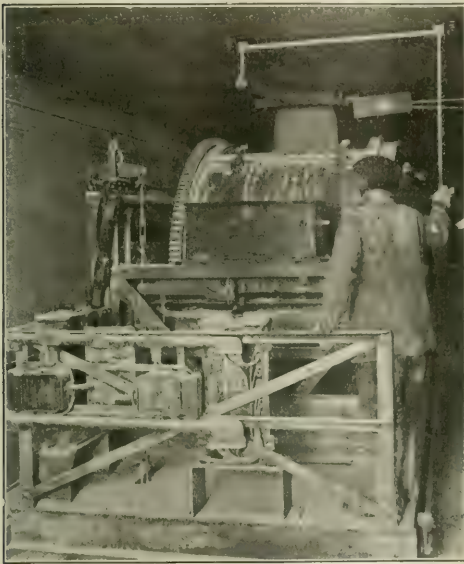
that date to this there has been a continuous record of life and growth. The history of glass making in the famous Pennsylvania district dates back to about 1680.

It was, however, about 1800 before glass making as an industry of any comparative size and importance began to take its place as an important phase of American industrial life, though glass products have from the earliest dates been of vital use to an advancing civilization.

It would be a most interesting story if some one could tell us just how glass was made in some of the very early establishments. We have, of course, fragmentary evidences of one sort or another telling us many of the details of how the pots or other receptacles were fashioned, how the glassmaking materials were prepared, how the metal was worked in the pot and finally how the wares were fashioned for the various requirements. But if we did have a picture, clear in detail, portraying to us the materials and processes utilized in producing the wares required, it would startle us to see how many of those materials and processes are practically identical today with those of the early times. In many points little or no advance has been made, and there are certain well-informed men who believe that in some details we have even lost ground and that we now carry on certain things in ways even more primitive than the ways of the pioneers.

At least it seems indisputable that many things are done today around a glass plant in just the same way as those things were done many years ago. One prominent glass factory engineer recently made the statement that many things he could cite from his own knowledge are today being done just as they used to be done when he started in his engineering career over forty years ago. And if his forty years' experience were expanded back to a hundred years or more the story would require no essential modification. Let us keep clearly in mind this indisputable fact that even with its great antiquity and its wonderful development in some directions there are, nevertheless, many ways in which the glass plant of today is still a relic of the old days with their cut-and-try and then stand-pat policies without serious attempts to find out why or why not and without any serious study of the underlying problems and the paths of advancement opening out from such studies.

We shall deal here with the advancements that have been made and with the foundations that have been and are being laid for real development on



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An electric mixing machine in a modern glass factory. This machine mixes purified sand.

ordered existence but it is probable that their earliest glass came from Sidon and Alexandria.

The chief center of the glass making art was later transferred to Constantinople and it was due to the incentive created by the glass workers at Constantinople that the famous Venetian glass was developed. We commonly think of the Venetian glass as representing a very remote antiquity in glass-making, but even at that early day the making of glass wares was an old and well established art.

The oldest of the German glass work dates back to the sixteenth century, but previous to that, during the fifteenth century, window glass was in pretty general use in England.

Of the American glass industry it is well that we should have some perspective of the early developments. It was in 1608 at Jamestown, Va., that glass was first made in the United States and from

sound scientific reasoning. A close scrutiny of recent glass history will quickly reveal the fact that it is only within the past decade or so that such advancements along technical lines have been made. A decade or two ago the glass industry was practically the same, except in aggregate size, as it had been for many, many years, but a new force has made itself felt and distinct forward strides have been taken.

In our whole industrial fabric there has been in evidence during recent years a tremendous forward urge that has been manifested in all lines of



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Reheating the neck of a bottle in a furnace—an everyday scene in a glass bottle plant.

industry. It is very difficult at this time to make any analysis of such expansion because of the uncertainty of the extent of the war's influence. Assuredly the great World War did stimulate all production efforts and enliven creative genius but unquestionably we should still have a tremendous industrial awakening and expansion remaining in the history of recent years if all influences of the World War were obliterated.

This general and rapid industrial evolution has doubtless had its influence, in turn, upon the glass industry thus accounting in part for the great forward strides from any direct or indirect connection with this general development there has undeniably been started a very real epoch of genuine advancement in the glass industry. Some of our individual

glass concerns, more particularly the larger ones, have embarked upon plans of development and expansion that a few years ago would have seemed foolhardy.

Two incidentals which may well be pointed out in this connection show the general trend of events. Not many years ago it was uncommon in glass plants to analyze materials or to make any use of knowledge of the composition of the ingredients entering into the products and in not a few plants this question of analysis, testing and properly adjusting materials was an unknown province. Today this has all changed. A large number of plants have accurate testing and control systems in operation and even in the very small plants, or most of them, there is at least some realization of its importance and some attempt to take advantage of such information as can be gained from other glass men and from the dealers in glass house materials.

Another straw which indicates the direction of the wind is the demand that now exists for the services of the men with scientific training as they are being turned out from our various educational institutions. Until very recent years there were practically no men with such training available but now the number, while small, is increasing greatly and has reached substantial proportions, and it is most reassuring that such men are being absorbed into the industry as rapidly as they are being prepared and the supply is inadequate to meet the demand.

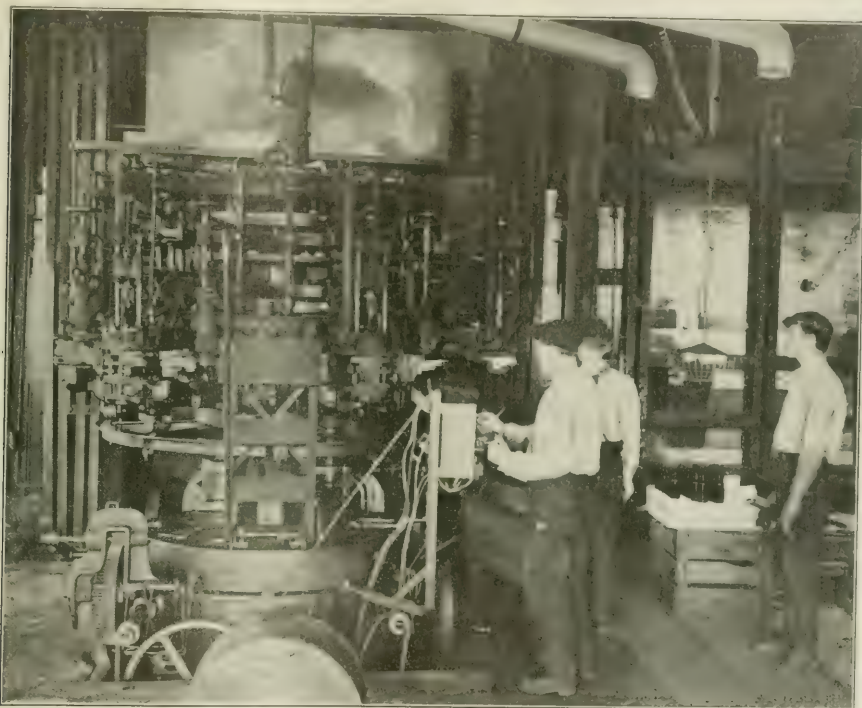
It may interest the general reader to have a mental picture of the aggregate size of the glass industry in the United States. There are in all about four hundred glass plants in the country, with about 200 million dollars of invested capital, with an annual value of output exceeding 150 million dollars and with a staff of workers numbering about a hundred thousand people. While it has already reached proportions that make the industry of great national importance its development is only well started and with the basis already laid the further expansion will surpass the fondest hopes of any present day dreamer.

Our modern development along purely mechanical lines has been marvelous. It is a constant source of wonder to all thoughtful people that mechanical means of accomplishing difficult and complex tasks are constantly being devised and improved. Of the glass industry that statement is particularly true. The growth of mechanically ingenious appliances has been marvelous and were it not for limitations imposed by lack of knowledge of glass and its properties the development would doubtless be far more startling. It is a pitiable contrast in the glass industry between the almost perfect mechanical adaptations on the one hand and on the other hand the fragmentary and imperfect use of what is today known about the chemistry and physics of glass house materials and processes. All this is slowly changing and a new era now dawning

will see the use of knowledge of the science of glass making take its proper place with the mechanical developments in processes of manufacture.

The blame, if any be attached to one or another of the parties having to do with development work, cannot be ascribed entirely or perhaps even partially to the managers and mechanical staffs, for it is only in very recent years that any great amount of scientific knowledge has been available for use and unfortunately early attempts made to use incomplete scientific knowledge frequently led to dis-

sufficiently sound basis to give confidence in any investigation work carried on at such elevated temperatures. Most glass making operations require the operation of furnaces at temperatures of 2,000 to 3,000 degrees Fahrenheit and it has long been recognized by the glass working fraternity that careful attainment and control of proper temperatures were of vital importance in the production of uniform and satisfactory ware, and obviously such control could not be well accomplished until the temperature could be accurately measured at least.



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The modern substitute for the glass blower—a machine which in complexity rivals the linotype. This machine which does all the work of turning molten glass into finished bottles, is now used in most of the up-to-date American glass plants.

astrous results and to the erroneous conclusion that science was of no use in the glass business. The conclusion in such cases should have been rather that science is particularly useful in glass making and that failure to recognize and take advantage of definite scientific laws was the obvious reason for any failure incurred and that a great reward lay before any organization that would work out the laws underlying the processes in question and properly utilize such laws.

The difficulties of carrying on researches at high temperatures are enormous. In the first place it is only in very recent years that the accurate measurement of high temperatures has been placed upon a

Even today there still remains the necessity of greater refinements in temperature measuring as applied to large glass furnaces and tanks. The fundamentals of accurate temperature measuring are satisfactory but the details of application so that the information thus gained will be of the greatest possible value in maintaining constant operation leaves much to be desired.

In temperature measurements one development of the past few years is of very great service, namely, the automatic signaling system. Details have been well worked out by which it is easily possible to have dangerously high or low temperatures indicated automatically by the flashing on of signal

lamps or the ringing of bells. The next step forward from automatic signalling of temperature variations is the automatic control of temperature. It is a perfectly logical development that devices which will indicate automatically when the temperature has either risen or fallen should be utilized to automatically increase or decrease the amount of fuel or other energy and thus to automatically control temperature. Distinct strides have been made in such automatic control, and within the next decade the development seems certain to exceed any present appreciation of what may be accomplished.

However, important accurate knowledge of high temperature measurements may be, it is but a small part of the scientific information necessary for satisfactory control of glass making and in a way it is a purely incidental knowledge. We must know what reactions actually take place between the materials used and the influence of surrounding conditions upon such reactions.

We know very little about the chemistry and physics of what takes place at high temperatures. It has been enormously difficult to study even the simplest relationship at elevated temperatures, and the silicates have been especially difficult to handle. Even after we have attained some sound fundamental knowledge of what takes place in simple mixtures of the silicates it is a staggering step from those simple relationships to a study of commercial mixtures involving complex relationships. However, some very distinct advances have been made. A groundwork of sound fundamental knowledge has been laid and future developments will be far more rapid and satisfactory than has been possible up to this time.

One general line of investigation that has already proven exceedingly profitable, and which promises greater and greater results in the future is the study of the properties of the molten glass, the variations in those properties with changes in temperature and the relation existing between composition and properties. Of particular importance from a strictly practical standpoint is the relation between composition of the metal and the rate of change of properties with changes in temperature. One phase of this problem on which a great deal of work has already been done and with fruitful results, is the study of viscosity and especially the viscosity-temperature relationship. Relatively small changes in composition produce marked effects upon this viscosity relationship and the influence of the addition of the less common glass materials like alumina and boric acid exert the most profound influences. There can be little question that the difference between success and failure of many automatic mechanical processes lies in viscosity changes which the metal undergoes during the process. Suitable changes, usually small, in the composition of the metal, will undoubtedly make possible many operations in forming wares which could not possibly be

accomplished without such changes and the resulting modifications in properties.

Another phase of such studies of the properties of the metal is in the relationship existing between the composition of the metal and its solvent action in attacking the pot or tank blocks. It is quite obvious that any changes in composition of the glass mix or of the pot mix must have corresponding effects upon the rate of attack of the pot. There are two general directions in which such a study may lead. It requires no proof that a container,



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The manufacture of carboys is an important part of the glass industry. Here workmen are shown cutting the necks of carboys.

whether pot or tank, which was entirely insoluble in the glass under the given conditions of manufacture, would be ideal. But there are no refractory materials, available in commercial quantities and at reasonable price, that approach very near to being insoluble in molten glass. Therefore the question must be handled with specific knowledge of the extent to which solution is taking place, if best results are to be secured. In some cases it will be most desirable to work toward the least possible solubility of the pot in the glass, and it is in this direction that most experiments along this line are carried out. It must be remembered, however, that great insolubility while very desirable from the standpoint of maintaining the glass free from any contamination, is at the same time undesirable in one particular that any fragments that may become detached will dissolve very slowly. The other direction in which such a study of solubility relationship may lead is toward the attainment of a relatively great solubility properly balancing on the one hand a slowness of dissolving that will insure

reasonable life of the containing vessel, and on the other hand a rapidity of solution that will make possible the complete disappearance in the glass of any particles that may become dislodged.

New artificial refractories will, without doubt, be developed for specific application to glass-making requirements and probably the resulting improvements will give us products that will be substantially insoluble in a given glass mix under given conditions. Certainly any development leading to greater insolubility of the container is greatly to be desired, and it is in such direction that the greatest developments seem likely.

That a new era of progress in the glass industry is at hand is attested to by the number of new products that have recently taken their places in the list of commercially available articles. One of the most widely known of these new products is cooking ware, the direct result of the application of scientific methods and knowledge to glass making. Of great importance as illustrating the new era of development are the chemical glasswares, optical glasses, new signal glasses, and special glass to accomplish required light absorption in various parts of the spectrum from infra red to ultra violet. These latter glasses are of great importance in the spectacle and goggle industries.

In some ways the most convincing evidence of a new and wide development along glass lines is offered by the formation of new organizations, the avowed purpose of which is to advance the science

and art of glass making. Abroad there are many such evidences. One of the most noteworthy is the formation in England of an institution with government support devoted to research in the problems of glass manufacturing. Also in England is the recently formed Society of Glass Technology, which represents in its membership and its program of activity a most commendable joining of the theoretical and practical phases in promoting the solution of the problems at hand.

Here in the United States a great increase in interest in the technology of glass making is shown by the formation of a Glass Division within the American Ceramic Society, the only technical organization in the country devoted to the silicate industries. The Glass Division is the largest and most active of the society's divisions and its rapid and broad growth is indicative of a tremendous expansion now well begun.

The future in the glass industry is exceedingly bright. A very definite start has been made in unshackling the general problem of glass manufacturing from the fetters of ignorance of scientific laws in which it has for ages been held. Real progress is now being made in solving the difficult questions as to what actually happens during the melting and fining of glass. The industry is now in a stage of development and advancement that will doubtless far surpass the wildest dreams of the most optimistic among us today, both in productive ability and economy.

The Canadian Pulpwood Question

RECENTLY we had occasion to refer in these columns to the situation in the United States which had brought about the passage by the Senate of a resolution favoring the appointment of a commission to negotiate with the Canadian provinces with a view to obtaining a removal of the restrictions on the export of pulp wood cut on Crown lands.

Some discussion of this move on the part of the Senate has occurred within the last week or so in the pages of the Canadian press but unfortunately the issues at stake are so obscured, that perhaps a re-statement of the question from the American viewpoint will not be amiss.

The purpose of the Underwood resolution is not the ruthless exploitation of the forest wealth of the Canadian Provinces. It aims simply at an amicable convention that will release raw material in the form of pulpwood to the United States without restrictions, just as the United States gives of its raw material in the form of coal, oil, and cotton to its sister nations.

The total present annual consumption of wood by the newsprint mills of the United States is about 2,000,000 cords.

Quebec, for example, has a total area of Crown lands of 190,000 square miles in round numbers. Of this area, 70,000 square miles are now leased, while 120,000 square miles are untaken. Premier Gouin is authority for the statement that four to five times as much timber could be cut from the leased Crown lands of Quebec as is cut at present without impairing the forest value of these lands.

This means that the present annual growth of the forests on the leased Crown lands of Quebec is four or five times as great as the present cut.

It is a well-known fact that the cutting of the matured timber in a forest, thus opening the woodlands up to sunlight and air, promotes the growth of standing trees. The 70,000 square miles of leased Crown lands in Quebec are equivalent to 44,800,000 acres. At the estimated stand of an average of 5 cords to the acre, this gives a total stand on these lands of 224,000,000 cords of wood. With an estimated annual growth of 4%, the annual growth on the leased Crown lands would amount to 8,960,000 cords.

The present cut of timber on the leased lands in Quebec is stated by Premier Gouin to be one billion (1,000,000,000) feet, the equivalent of 2,000,000

cords. Thus, his statement is proved, as the annual growth is estimated at 8,960,000 cords, which is just about four and one-half ($4\frac{1}{2}$) times the present annual cut.

Those who hope to see the purpose of the Underwood resolution achieved, expect that the Provinces will impose more scientific and rigid lumbering regulations than obtain at present, and that they will limit the cut to the estimated growth of the Crown land forests.

Thus, should the Provinces agree to cancel the present export restrictions, the Crown Land forests would be able to supply many times the needs of the American pulpwood market without impairing the national forest asset.

Using the same basis of computation, all the Crown lands of Quebec, leased and unleased, totaling 190,000 square miles, contain 121,600,000 acres. At an average of 5 cords to the acre, this represents a total stand of timber of 608,000,000 cords. The estimated annual growth of this large stand would be 24,320,000 cords, which could be cut and removed without reducing the size of the forest or its value to the Province.

Should Quebec consent to lift her export restriction on Crown land wood, leases of the more remote limits would be purchased at large bonus prices per square mile, the Provincial receipts from ground rentals would be greatly increased, the receipts from stumpage fees (96 cts. per cord) would be augmented in proportion to the extent of the lumbering operations which have the possibility of reaching the enormous total of \$24,000,000 a year, and labor in Quebec would share in all of the large expenditures that would be required to improve the rivers, build preparing plants, and harvest the pulpwood in the enlarged operations.

The same computations apply with equal force to Ontario and New Brunswick, Quebec having been selected as the example on account of its proximity and its great forest wealth.

The opposition in Canada to the purpose of the Underwood Resolution comes chiefly from the larger paper manufacturers, whose views find ex-

pression in the columns of the financial and trade press of Toronto, Ottawa and Montreal.

These manufacturers have nothing to lose by the removal of the export restrictions on Crown land wood, because they are amply protected by leases of extensive limits, secured in early days at merely nominal bonus prices per square mile.

The following table gives a clear idea of the extent of the limits held by the leading manufacturers in Canada respectively, together with the estimated stand of timber on their limits, the estimated annual growth and their actual pulpwood needs to operate their respective plants to capacity:

Name of Company	Crown lands owned Acres	Estimated annual amount stand growth of wood 4% per annum required Cords annually Cords		
		Estimated at 5 cords per acre Cords	Estimated growth of 4% per annum Cords	Estimated amount required annually Cords
		(000 omitted).		
Belgo-Canadian P&P Co.	1,065	5,327	213	105
J. R. Booth	1,547	7,737	309	93
Brompton P & P Co.	135	675	27	130*
Donnacona Paper Co.	119	598	23	66
E. B. Eddy Co.	432	2,160	86	65
Laurentide Co., Ltd.	1,668	8,342	333	195
Ontario Paper Co.	200	1,004	40	91*
Price Bros. & Co.	4,350	21,750	870	148
St. Maurice Paper Co.	980	4,902	196	99
Total	10,499	52,498	2,099	995

*These companies buy the balance of their requirements.

With these vast reserves of timber to depend upon, which economically and scientifically lumbered, will supply the raw material requirements of the Canadian mills indefinitely, the opposition expressed might, to the uncharitable, indicate the attitude of a dog in the manger. But an analysis of the situation rather indicates clever trading tactics, as strong intimations have been received by those interested in the success of the Underwood Resolution that the Canadian manufacturers could be induced to concede the fairness of removing present export restrictions, provided they could secure other advantages in the market of the United States in addition to the free entry of their product which they have enjoyed for nine years and which has expanded the Canadian industry far beyond the optimistic dreams of those whose early vision perceived the possibilities of building up a great paper business in the provinces.

Drug Association Demands Protection

IN his annual address at the ninth annual meeting of the American Drug Manufacturers' Association held in New York early this month, President R. C. Stofer came out strongly for the protection of the American chemical and dye industries by the Government.

"To now grant the admission of German chemicals except under strict regulative conditions would be in my opinion a breach of faith on the part of the Government. While in list of chemicals

. . . there are many which are not now manufactured in America, unquestionably as the chemical industry develops, there will from time to time be material additions to the list of American made chemicals. Every possible protection must be accorded the development of these infant industries and of the workers necessary for the production of chemicals and dyestuffs, which will ultimately prove whether in peace or in war, a strong economic factor in our national life."

Diatomaceous Earth in Industry

This material so widely used in modern industry is found not only in the Western states but is well distributed in many of the Eastern States as well.

By W. C. Phelan

Mineral Technologist, Bureau of Mines

THIS brief paper has been prepared with the view of placing on record in available form information with reference to this rather abundant and useful material. Another reason for its preparation is the fact that it does not appear to be well known that diatomaceous earth is rather widespread in its occurrence; is not confined to the western part of the United States, especially California, but is well distributed in many eastern states, where the demand should be greatest owing to the larger number of industrial operations requiring abrasive materials of all kinds.

Diatomaceous earth is more commonly known as infusorial earth, and is sometimes referred to by its German name, "kieselguhr." It is also, though erroneously, called tripoli. It is composed of the siliceous remains of minute aquatic plants known

most of the known beds of great thickness are of this age.

In chemical composition, diatomaceous earth is a hydrous silica or opal, but as a rule it contains a considerable quantity of earthy impurities. A very simple test, taken in connection with other distinguishing characteristics, is that when touched with hydrochloric acid it does not effervesce. Sometimes analyses from widely separated localities show great similarity of composition; as, for example, the first three analyses below:

The chief use of diatomaceous earth is as a cleanser and polisher, and for these purposes it is used in the form of a powder or mixed with soap. It is a most effective non-conductor of heat, and has been used alone or with various compounds in covering for boilers, steam pipes, furnaces and

	1	2	3	4	5	6	7	8
Silica (SiO ₂)	80.53	80.66	81.53	75.68	65.62	86.92	72.50	86.89
Alumina (Al ₂ O ₃)	5.89	3.84	3.43	9.88	...	4.27	11.71	2.32
Iron Oxide (Fe ₂ O ₃)	1.03	...	3.34	2.92	...	...	2.35	1.28
Lime (CaO)	0.35	0.58	2.61	...	...	1.60	...	0.43
Magnesia (MgO)	...	...	...	...	...	Trace	...	Trace
Potash (K ₂ O)	...	...	1.16	...	...	2.48	1.88	3.58
Soda (Na ₂ O)	...	...	1.43	...	...	...	...	...
Water (H ₂ O)	12.40*	11.01*	6.04*	...	11.00	5.13	9.54	4.89
Nitrogenous Matter and Moisture..	...	...	...	9.21	...	...	...	...
	99.83	99.69	99.54	98.77	76.62	100.40	99.13	99.39

* Water and organic matter.

as diatoms, which are of minute proportions, as a general rule, and have to be identified chiefly by aid of the microscope. The organic matter of these plants has long since disappeared from most of the deposits, but there are notable exceptions, as in California.

These low forms of plant life secrete silica much after the same manner as mollusks secrete lime, and thus build up their shells. It is this part of the plant which makes up the formations found in nature. The siliceous parts accumulate on the bottoms of the bodies of water in which the plants lived, and in time attain considerable thickness, and become of economic importance. The diatoms may live in either fresh or salt water, and under widely varying conditions of depth, pressure and temperature. For example, they have been found in the depths of the Atlantic Ocean, and are known to occur in the warm springs of Yellowstone National Park, to cite two extremes of temperature, pressure and difference in the character of the water. The material is now in process of formation, and although it has in times past been formed in very different epochs, it is especially abundant in the Tertiary and

stoves, and in the manufacture of fireproof cements.

It has great absorbent qualities, as will be noted from the fact that its specific gravity, bulk for bulk, is only one-third that of water, namely 0.33. Its absorbent quality makes it suitable for water filters. The statement has often been made in the literature that it has been used in the manufacture of dynamite, but I understand that its use for this purpose has long since been entirely supplanted by wood pulp, on account of the danger from particles of grit. Boiled with shellac, it is used in the manufacture of records for talking machines.

Its uses abroad have been more numerous than in the United States. It had been used in Europe for the absorption of liquid measures so as to make the latter conveniently available as a fertilizer. It has also been used in the manufacture of water glass, in making cement, in tile glazing, artificial stone, ultramarine and other pigments of aniline and alizarine colors, paper filling, sealing wax, fireworks, hard rubber objects, matches, papier mache, as a container for liquid bromine, and for miscellaneous minor purposes.

In California, it has been used in the construc-

tion of buildings, advantage being taken of its property of being readily cut into any desired shape or size. In some of the California reports, it is referred to as shale. It is easily quarried, and the small blocks into which it may be cut are light in weight, and placed easily in position.

A number of buildings have been successfully constructed of this material in the Lompoc district, Santa Barbara County, California. The blocks are compact and elastic under temperature changes and appear to possess sufficient strength. They are, moreover, very resistant to weathering on account of the insolubility of their chief constituent, silica. Such building material appears to be especially well adapted to regions of earthquakes or tremors, owing to the probable lesser effect of shock on such a light substance and the minimum amount of damage and danger resulting from its wall. In powdered form the material has been used to a certain extent in California in the manufacture of plaster.

In preparing the earth for industrial use, it is first roasted to expel as much water and organic matter as possible. It is then transferred to a furnace and heated to a moderately high temperature, but with the exercise of sufficient care so as not to destroy its porosity by over-heating. It is then finely ground between rollers, sifted and sacked to prevent reabsorption of moisture. For certain purposes it is only necessary to give it a prolonged drying at a high temperature prior to grinding and sifting.

In Santa Barbara, California, the material is broken in open air quarries and as mined contains a considerable percentage of moisture. After forty to fifty days of drying in the dry atmosphere of Southern California, the material still contains a small percentage, approximately 5 per cent., of moisture. Some of the material after air-drying is sawed into bricks or other shapes and dried in kilns. Such bricks are used for insulating purposes. The rest of the material is finely powdered in mills and sacked to be used for filtering. Quarrying is done by electrically driven channelling machines. Some of the California material contains 5 per cent. of alumina, presumably in the form of clay, which acts as a binder. This material is adapted to the use of building blocks for interior fireproof walls, and contains about 85 per cent. silica.

One of the deposits near Lompoc, namely, that of the Celite Products Company, formerly the Kieselguhr Company of America, comprises extensive beds of soft white earth in a very pure state, both thin and massive. These form a cap over the hills and overlie brown siliceous shales and are conformable with them. The strike is east and west and the dip is 30° south. This material is being quarried in open cuts. It is taken up in large blocks and air dried in the quarry. It takes from forty to fifty days to reduce the water content, which ranges from 25 to 45 per cent. by weight to 5 per cent.

It is then hauled by motor trucks to the plant at Lompoc, where it is ground to powder and transferred to the different warehouses by a pneumatic system. When blocks are required, the material is transported in its natural state direct from the quarry, sawed to the required sizes, and dried before shipment. The material, when dried, is utilized in making brick, tile and other refractory materials.

The quarry operations are readily carried out where transverse joints occur in the strata, due to earth movements. Where these are not present to facilitate removal of the rock, it is necessary to loosen it slightly by means of powder before blocks can be removed from the quarry face.

On account of the quantity of absorbed surface water in the diatomaceous earth, it is necessary that it be split into convenient blocks for drying.

That infusorial earth is a widely distributed commodity in the United States is evident from the descriptions given below. The localities outlined are doubtless far from being a complete list. They are given principally to indicate the wide spread occurrence of the material.

Maine.—A deposit of diatomaceous (infusorial) earth of unknown extent is reported to have been worked in South Biddington, Washington County. The material is said to be of pure white color and of unknown extent.

New Hampshire.—Beds of diatomaceous earth are reported from the vicinity of Lake Umbagog. An analysis of this material is given above.

Massachusetts.—Beds of infusorial earth are said to occur near South Framingham.

New York.—Two deposits of infusorial earth are known in the State of New York, namely, at White Lake, Herkimer County, and at Cold Spring Harbor on Long Island. It is likely that careful prospecting will reveal other deposits in some of the larger peat bogs and marshes of the state.*

New Jersey.—Near Drakesville there occurs a deposit which covers a small acreage to a depth of 1 to 3 feet.

Maryland|—Infusorial earth has been mined along Lyons Creek, a branch of the Patapsco River, separating Calvert and Anne Arundel counties. The location is 5 miles west of Herring Bay, on the west shore of Chesapeake Bay. Deposits are also known extending from Fairhaven on Herring Bay to Pope Creek on the Potomac River. It occurs at the base of the Calvert formation, which is Miocene (Tertiary).

Virginia.—Diatomaceous earth occurs also in the Calvert formation of the Chesapeake group in the vicinity of Richmond, Va. The lower beds of the foundation, chiefly those between 5 to 20 feet from the base, contain diatom remains in sufficient

* *Pagson, A. L., Peat, Its Formation, Uses and Occurrence in New York, 57th Ann. Rept., N. Y. State Museum, Vol. 1, Sec. 1 (or 23d Ann. Rept. State Geologist, Part I); 15-80-1905.*

quantity to entitle it to be termed diatomaceous earth. In weathering, the portions rich in diatom remains become nearly pure white. The material is of very fine texture, and is very light gray to white in color. Its lightness is characteristic, having a specific gravity of only 0.33 bulb for bulk. It outcrops especially in the valley of Shockoe Creek. The available material here is not so great in extent as at some other localities in Virginia and Maryland. The purer deposits are soft and clay-like, and when dug are very porous, with a white or slightly yellowish tinge.

Florida.—The Florida deposits of diatomaceous earth have been formed in fresh water, and are of comparatively recent date. A deposit located at Eustis, which has been worked to some extent, is in general appearance very much like the peat bogs of that section. The diatomaceous earth is, in fact, intimately mixed with peat or muck, and the material as taken from the bogs looks like peat of a grayish color. The method of treatment is to burn out the carbonaceous matter, leaving the siliceous material as a very fine white powder. The deposit in this bog has a thickness of 20 feet or more.

About 3 miles east of Tavares, on the north side of Lake Dora, is a bog of peat prairie type covering 100 acres. In 1901 a plant to treat the infusorial earth was erected on the north edge of this prairie, a few hundred feet from the Sanford and Eustis division of what is now the Atlantic and Coast Line railroad. The peat was dug by hand to a depth of about one foot, conveyed mechanically up an incline to the top of a building, and there dumped into a machine which pressed out the bulk of the water. From here it was taken to a shed, spread out to dry, and afterward burned in a suitable furnace. It is reported that the product was at first shipped to England for use in the manufacture of scouring soap.

Besides the occurrence near Eustis, Lake County, a number of samples of similar material have come from Polk County.

New Mexico.—Near Socorro, N. M., there is stated to be a deposit of fine quality which out-

crops in one place 1,500 feet long and with a thickness of 6 feet.

Nevada.—A deposit of diatomaceous earth is reported in a railroad cut west of Reno, Nev., with a thickness not less than 300 feet, and varying from a pure white to a pale buff, or canary color.

Oregon.—Near Linkville, Klamath County, Ore., there occurs a deposit of infusorial earth which has been traced a distance of 10 miles along Lost River, and it shows a thickness of 40 feet.

Idaho.—Beds of diatomaceous earth are known to occur in Idaho.

Washington.—Beds of diatomaceous earth are known to occur near Seattle, Wash.

California.—There are a number of deposits of infusorial earth in California. The most important thus far developed are in Santa Barbara, Monterey, Orange and San Luis Obispo counties. The material in Santa Barbara County is of superior quality and has been worked on a commercial scale. Infusorial earth is also found in Fresno, Kern, Los Angeles, Plumas, San Benito, San Bernardino, San Joaquin, Shasta, Sonoma and Tehama counties. During 1918, five quarries operating in Monterey and Santa Barbara counties produced a total of 36,000 tons of this material, valued at \$190,000. The most important deposit is that of the Celite Products Company, formerly the Kieselguhr Company of America, the name having been changed during the war. The quarry and mill of this company are at Lompoc, Santa Barbara County. This company has rapidly increased the scope of its dust operations, and it is reported that it expects to still further increase them. There is still another operation in the same vicinity by the name of La Salle Canyon quarry. Near Bradley, in Monterey County, there have been two small operations, and possibly a third. The deposits of northern Santa Barbara County have been described in great detail, and their real extent indicated in a bulletin by Ralph Arnold and Robert Anderson.*—Bureau of Mines, Reports of Investigations.

* Bull. U. S. Geol. Sur., No. 315, 1906, Part I, Pages 438-447.

The Sulphur Content of Coal

By A. R. Powell

Physical Organic Chemist, Bureau of Mines

AN investigation has been made of the applicability to a variety of coals, other than those from Illinois, of the Powell and Parr method of analysis for the forms of sulphur in coal.

A complete study was made of the sulphur in the following coals: Upper Freeport, Pa.; Pittsburgh seam, Pa.; Pocahontas No. 3, W. Va.; Letcher Co., Ky.; Morgan Co., Tenn.; and Cherokee Co., Kan.

The method of analysis gave excellent results

when applied to these coals. In the determination of pyrite, the iron-sulphur ratio checked in every case with the theoretical. After the extraction of the pyrite and sulphates, the remaining sulphur was proved to be organic in nature.

This work indicated that sulphur exists in coal in three typical forms: pyrite or marcasite, sulphates, and organic sulphur. A study of the changes which these forms undergo during coking has been made

on a variety of coals, and the following five classes of reactions established:

First. Complete decomposition of the pyrite and marcasite to ferrous sulphide, pyrrhotite, and hydrogen sulphide. This reaction begins at 300° C., is complete at 600° C., and generally reaches its maximum between 400 and 500° C.

Second. Reduction of sulphates to sulphides. This reaction is complete at 500° C.

Third. Decomposition of the organic sulphur to form hydrogen sulphide. From one-quarter to one-third of the organic sulphur is so affected in the primary decomposition, but the by-product gases traveling through the coking mass increase this reaction to as much as one-half of the organic sulphur present. Primary decomposition is most active below 500° C.

Fourth. Decomposition of a small part of the organic sulphur to form volatile organic sulphur compounds. The greater portion of these find their way into the tar. This decomposition occurs at the lower temperatures of the coking process.

Fifth. Disappearance of a portion of the ferrous sulphide and pyrrhotite, the sulphur apparently entering into combination with the carbon. This reaction seems to be most active in the neighborhood of 500° C. and higher.

The organic sulphur not accounted for by the above reactions undergoes a decided change in

character between 400° and 500° C. and shows none of the properties of the original coal sulphur.

From these experiments, it would not seem that the relative amounts of pyrite and organic sulphur in the coal have much effect on sulphur distribution during coking.

Methods for changing the sulphur distribution were studied so that the minimum amount of sulphur would be retained in the coke. A complete study was made of the efficiency of hydrogen and gases containing hydrogen as desulphurizing agents when passed through coal in the process of coking.

The effect of the hydrogen on the removal of sulphur from coke was very noticeable, in some cases nearly all of the sulphur being removed as hydrogen sulphide during a period of three hours. The ordinary sulphur coking reactions were affected in two ways by the passage of hydrogen through the coking mass; (1) the pyrite was caused to decompose at a much lower temperature; (2) the coke sulphur, which is presumably in combination with carbon, was eliminated at an almost constant rate at the higher temperatures of the coking process.

The size of the particles of coal did not seem to affect the rate of evolution of hydrogen sulphide so far as our tests went.

For gases containing hydrogen, the desulphurizing efficiency seemed to be proportional to the partial pressure of the hydrogen.

Vegetable Oils of Trinidad

THE only vegetable-oil product of commercial importance in Trinidad is coconut oil, the output of which is approximately 140,000 gallons per annum, with a possible maximum, however, of 180,000 gallons, says U. S. Consul Henry D. Baker in *Commerce Reports*. The production is influenced to a very large extent by the prices paid for copra. If the market for copra is relatively high as compared to coconut oil, the tendency is to export copra, instead of using it locally for the extraction of coconut oil. As, however, coconut oil is a necessity in the food diet of a large portion of the local population (including all the East Indians, who constitute about one-third of the population and who will not make use of animal fats) the local government would always insist on a substantial production of coconut oil before allowing any exportation of copra.

The export of coconut oil from Trinidad was forbidden during the war, as it was considered necessary to conserve local supplies for home use. The local government establishes a maximum price at which coconut oil and meal may be sold. In November, 1919, these prices were \$1.60 per gallon for the oil, and not over \$0.025 per pound for the meal.

There are six factories in Trinidad making coco-

nut oil, the three most important being in the Mayaro coconut district on the east coast of Trinidad, which produce together about 100,000 gallons of oil per year. Of the three other factories, one in Port of Spain produced in 1918 about 25,000 gallons, one in the Montserrat coconut district (in the southern part of the island) about 16,000 gallons, and one in the Cedros district (in the southwestern part of the island) about 250 gallons.

The only other vegetable oils produced in Trinidad (and these not in any commercial quantity) are castor oil, obtained from castor seeds, the cultivation of which started to a small extent during the war, in order to meet the great demand for its use as a lubricant for aeroplanes, but in which little or no interest is now shown; crab oil from the seeds of the crab-bean tree, which is used locally for clearing stock of parasites, ticks, etc.; and hunterman's oil, made from the seeds of a large forest liane or rope vine, which is considered a good substitute for castor oil as a purgative.

Development of the nitrate fields of northern Chili and Bolivia is expected to result from improvements of the port of Antofagasta, which now are in progress at a cost estimated at £1,700,000.

Plant Expansion and Export Trade

Is American industry as a whole overbuilt? A careful review of the situation seems to indicate that as a whole plant expansion during the war did not proceed at a more rapid rate than during peace.

CURTAILMENT of exports from the United States to Europe is in process as a result of the high premium on the dollar abroad. It therefore becomes a most pertinent question as to whether plant expansion during the period of the European war proceeded at a more rapid rate than during the periods of equal length under the normal conditions of peace time.

A satisfactory answer to the question would receive data for each industry separately, for while some lines such as shipbuilding expanded remarkably during the war, others failed to keep up their normal growth, as was the case with the railroads, or output was actually curtailed, as was true of those industries producing building materials.

Dr. Wesley C. Mitchell studied for the War Industries Board the question of the production of raw materials during the war. His results appeared in April, 1919, issue of the Federal Reserve Bulletin. Based on ninety raw materials, and using 1913 as the base year, he figured that production for 1918 was 16 per cent. over production for 1913. For each year from 1914 to 1918 it was as follows:

PRODUCTION OF RAW MATERIALS (1913 = 100)

Year.	Increase Per Cent.	Decrease Per Cent.
1914	..	1
1915	7	..
1916	11	..
1917	14	..
1918	16	..

The number of tons of revenue freight handled by the railroads is usually regarded as a rather good measure of the expansion of business. Comparing 1918 with 1913 as to revenue tons handled by Class I railroads (about 90 per cent. of the total mileage, 1918, shows an increase of 20 per cent. over 1913). The following table shows year by year the revenue tonnage handled by Class I roads, together with the per cent. increase or decrease each year, using 1913 as the base:

Year Ending June 30.	Revenue Tons Handled by Class I Roads.	Per Cent. Increase, Decrease. (1913 = 100).
1913 (base)	1,915,001,926	..
1914	1,843,216,056	.. 4
1915	1,684,659,517	.. 12
1916	2,093,092,757	..

Calendar
Year.

1917	2,270,035,053	19 ..
1918	2,305,868,245	20 ..

Increase from 1913 to 1918 has no particular significance except in relation to what might be called a normal increase. It is very difficult to determine what constitutes such an increase. Comparing the

total tonnage handled for the five years, 1908 to 1912, with the total tonnage for 1903 to 1907, the increase is found to be 15 per cent. Making a similar comparison for the total tonnage handled for the five war years 1914 to 1918, with the five years 1909 to 1913, the increase is 18 per cent. On the basis of the rate of increase for these two five-year periods, it would seem that the rate of increase from 1914 to 1918 was a little faster than the ordinary rate, but the evidence is not inclusive.

Turning to the specific industries the total annual blast furnace capacities increased from 44,405,000 gross tons in 1914 to approximately 50,000,000 in 1919. These figures relate to the condition at the end of each year. The increase in capacity for the five years was 5,595,000 tons, or 13 per cent. There are now four blast furnaces under construction which will have a total annual capacity of 700,000 tons. The increase in capacity from November 1, 1907, to December 31, 1912, was 8,423,100 tons, or 24 per cent. Thus, it does not appear that measured in terms of world consumption American iron and steel expansion during the war was abnormal and that the industry is "over-built."

The pig iron production in the years from 1909 to 1919 is shown below:

Year	Production (Gross Tons)
1909	25,795,471
1910	27,303,567
1911	23,649,547
1912	29,726,937
1913	30,966,152
1914	23,332,244
1915	29,916,213
1916	39,434,797
1917	38,621,216
1918	39,054,644
1919	30,900,000

Although pig iron output increased 32 per cent. between 1915 and 1916, this was done with an increase of less than 2 per cent. in the annual capacity of the blast furnaces, from 45,033,825 tons to 45,864,525 tons. The increase was accomplished largely by using the existing equipment more nearly to capacity. Any consideration of blast furnace capacity must not overlook the fact that under normal condition the total blast furnace capacity of the country is not in use. This is due to the existence of so-called "high cost" furnaces, that is, blast furnaces badly located from the standpoint of ore and coal supply, old-model furnaces, etc. In other words, although total blast furnace capacity in this country is now around 50,000,000 tons, it is not requisite to sound business conditions that our furnaces operate to that capacity. Eighty-five per cent. capacity of the whole is regarded as excel-

lent. It is only under emergency conditions that full capacity is used.

The following table shows the growth in the number of spindles used in wool manufactures:

Year	No. of Spindles
1899	3,511,099
1904	4,021,098
1909	4,570,089
1914	5,006,286
1918	5,784,583

Annual figures are available for the total number of cotton spindles in the country. From 1909 to 1919 they were as follows:

Year	No. of Spindles
1909	28,573,435
1910	28,929,093
1911	30,803,662
1912	31,582,679
1913	32,149,617
1914	32,744,012
1915	32,840,730
1916	33,333,176
1917	34,221,252
1918	34,940,830
1919	35,443,156

The growth in the number of spindles used in silk manufacture is shown below:

Year	No. of Spindles
1899	1,655,903
1904	2,018,706
1909	2,415,527
1914	2,808,702
1918	2,939,797

Other factors besides number of spindles must be considered in relation to plant expansion in the textile industries. So far, however, as the situation is to be judged by spindles, it can be said that the war period showed no more rapid rate of development than preceding periods of equal length. The following table shows per cent. of increase in the number of spindles, for the three major textile industries, 1909, 1914 and 1918:

Industry	Per Cent. of Increase	
	1914 Compared with 1909	1918 Compared with 1914
Wool	10	16
Cotton	15	7
Silk	16	5

In order to draw any conclusions as to whether general plant expansion proceeded at an abnormal rate during the war, it is necessary as far as possible to compare the rate of expansion from 1914 to 1918 with the rate for similar periods under peace conditions. No very good measure is available, but the United States census of manufactures is helpful. It is obvious that physical volume cannot be measured by money values. The best census figures, therefore, are those for wage-earners employed in manufactures, and for primary horse-power.

The following table shows the per cent. of increase for these items for the last three five-year

intervals at which federal censuses of manufactures were taken:

	Per cent. of Increase		
	1904 Compared with 1899	1909 Compared with 1904	1914 Compared with 1909
Wage earners (Av. No.) ..	16	21	6
Primary horse-power	34	39	21

It should be noted that the increase from 1909 to 1914 is shown as abnormally low, because the census of manufactures of 1914 covered a period of industrial depression, but these results point to the conclusion that plan expansion from 1914 to 1918 was not abnormal.

From the beginning of the war in Europe until April, 1917, it seems probable that actual physical plant expansion in this country was proceeding at an abnormal rate in many lines; but from the moment of our entry into the conflict, because of the withdrawal of men into camps, general expansion was retarded, expansion henceforth being directed into those lines necessary for war purposes, while other industries were correspondingly retarded. The following is a partial list of industries which were operating on a restricted basis under War Industries Board orders on September 26, 1918. Operations are expressed in per cent. of decrease compared with 1917 production:

Article	Per Cent. of Decrease Sept., 1918 Compared with 1917
Passenger automobiles	75
Pianos, piano players and parts	67
Cutlery (including government orders)	30
Stoves (including government orders)	50
Black galvanized and enameled ware (including government orders)	50
Metal beds (including government orders)	50
Boilers and radiators	60
Automobile pneumatic tires	50
Tin plate	70
Agricultural implements and farm tractors	75

Curtailment in building operations is a matter of common knowledge. It is possible to measure accurately the reduction in the production of building materials.

Material	Per Cent. of Decrease 1918 Compared with 1917
Lumber	15
Structural steel	32
Portland cement	22
Common brick	69
Indiana building stone	96

Production undoubtedly was concentrated in certain lines in which output was increased, either by new plant development or by diversion. By way of illustration carpet looms were diverted to cotton duck production. Plant expansion for the production of explosives and chemicals is a matter of common knowledge. Great expansion occurred in those ferrous or non-ferrous metal industries whose products were used for munitions. However, it is not possible to measure this expansion.

The problem, therefore, is a special not a general one. The chief non-ferrous metals are a case in point. There is no measure of the plant expansion which was necessitated by the war demand for these metals, but production data are available. The following table shows copper, zinc, and lead output from 1909 to 1919:

Year	Copper Smelters Output (Short tons)	Zinc Refined from Domestic Ores (Short tons)	Lead Refined from Domestic Ores (Short tons)
1909	546,476	230,225	352,839
1910	540,080	252,479	375,402
1911	548,616	271,621	391,995
1912	621,634	323,907	392,517
1913	612,242	337,252	411,878
1914	575,069	343,418	512,794
1915	694,005	458,135	507,626
1916	963,925	563,451	552,228
1917	943,060	584,597	548,450
1918	954,267	492,405	539,686
1919	639,000	446,000	431,000

The increase production in 1916 was very marked in the case of each of these metals. The lowered output in 1919 was the result of definite efforts to curtail production. This country needs export markets for copper, zinc and lead. We need export markets adequate to absorb surplus cotton Oleo oil, meat products, wheat, etc. During the war there was a very marked expansion in our exports of manufactures ready for consumption. Part of this game ought to be held in 1918 and in 1919 there was a decided increase in the proportion of food-stuffs partly or wholly manufactured, to the total value of our exports. We are fast getting back to pre-war conditions, however. Practically the only difference in the percentage distribution of our exports amount the large group of articles in January, 1920, from the year 1913 was that there were relatively more food-stuff partly or wholly manufactured and less manufactures for further use in manufacturing. The 1913-1916-1919 and January, 1920, distributions are shown below in percentages:

Class	1913	1916	1919	Jan. 1920
Crude materials for use in manufacturing	32	13	21	33
Foodstuffs in crude condition and food animals	7	8	9	6
Foodstuffs partly or wholly manufactured	13	12	25	19
Manufactures for further use in manufacturing	16	17	12	11
Manufactures ready for consumption	32	48	33	31
Miscellaneous	*	2	*	*
Total	100	100	100	100

*Less than one per cent.

General exports from the United States doubtless increased during the war. In order to eliminate as far as possible the effect of increased prices a study has been made of the increase in the physical volume of the principal exports during the years 1913 to 1919. The values of these commodities represented 50% or more of the total values of exports in each year. The following table shows the increase or decrease in the physical volume of exports, according to our method of computation, for

each fiscal year from 1914 to 1919 using 1913 as the base.

Year ending June 30	Physical volume of exports 1913=100	Increase Percent.	Decrease Percent.
1914		..	6
1915		10	..
1916		46	..
1917		62	..
1918		14	..
1919		27	..

A similar study was made for the Federal Reserve Board, and was published in the Federal Reserve Bulletin for October, 1919. For that study the average of the years 1910-1914 was used as a base, and the list of commodities was rather more restricted than that used in the study for our own bank. In 1917, for instance, the Federal Reserve Board list of commodities covered only 39 per cent. of the total exports. Their results were as follows:

Year ending June 30	Physical Volume of Exports Average 1910-1914 = 100	Per Cent. Increase
1915		26
1916		21
1917		23
1918		9
1919		35

It should be noted, however, that shipments for military purposes, insofar as they were carried on government vessels to supply the army and navy abroad, were not reported as exports. The War Department shipped 7,541,260 tons of goods on government vessels from April 6, 1917, to June 30, 1919, while the Navy Department shipped 1,090,724 tons from May, 1917, to December, 1918. So far as they consisted of foodstuffs and clothing, they were partially at least offsets to curtailment of domestic consumption. Shipments of military supplies other than food and clothing, however, represented a larger expenditure of labor and materials per unit weight than did the general run of domestic exports from the United States, even though the actual volume, compared to our export total, was small. It is not possible to adjust the above analyses to include these exports.

Under ordinary peace conditions, of course, there is regularly an increase in exports. No study has been made of the rate of such increase, however, in terms of physical volume. The value of domestic exports for 1913 showed an increase of 31 per cent. over the value of exports for 1907.

As any country matures industrially it needs export markets, in part to pay for those raw materials and other commodities which it must buy abroad, and in part to stabilize its industries by the development of markets in which it may sell in order to minimize the effects of domestic depressions and seasonal variations in domestic conditions. An exporttrade, however, implies a surplus. No permanent advantage is to be gained by exports which produce a scarcity in the domestic market.

So far as evidence is available, the conclusion is not to be avoided that considering our industry as a whole, plant expansion in the United States during the war did not proceed at a more rapid rate than in peace time. Such expansion was irregular, however, as between different industries, with the result that some industries are more dependent than before the war on an export market. The problem is special, not general, and plant capacity and output must be increased in many industries before it becomes possible to export a large share of the total production.

During the month of March twenty-seven new companies with an authorized capital of \$50,000 or over were formed in the United States to manufacture chemicals, drugs and dyes. The total authorized capital of these new companies was \$29,660,000. In February sixteen companies were formed with a total capital of \$12,585,000 and in January, forty-seven with a capital of \$17,943,000.

During the first four months of the present year corporations with an aggregate authorized capital of \$60,188,000 has been formed. During the same period in 1919 the total was \$23,475,000.

—Commerce Monthly.

Dye Industry Needs More Research

By CHARLES B. DAVIS, F.C.S.

THE dye industry is in a state of chaos, due to insufficient research. The graduate chemist of today, whose education has been limited by a teacher who gives only the facts, is unqualified for this class of work in the industries. The underlying principles of the science, a knowledge of which would enable the scholar to think for himself and interpret the truth, are neglected. But how can we expect to obtain research men direct from institutions of learning, where the instructors are out of contact with the industries? The majority of chemists can conduct a mineral or an organic analysis but when it comes to reproducing the product under investigation, they are all in the air. It takes years of practical experience to make a research chemist.

We hear of firms who employ as many as eight hundred chemists and still we have no fast dyes to market. This is partly due to the fact that the manager, knowing nothing of the science, is allowed to lay out the work for investigation. The manager should be a research chemist. A research chemist in order to accomplish results should not be hampered in his work. He should take, say a dye, and be left to carry out his tests for reproducing it. One such chemist would be able to reproduce or discover fast dyes of even the vat type, if he were given time and opportunity. The world is too quick to dismiss genius instead of encouraging it and giving the proper facilities for proving it. The eyes of the world must be opened to real genius.

The modern concern employing chemists expects results in too short a time. The failure of a certain set of tests or reactions today, may be the success of the process tomorrow. Thus, success in chemical research is the result of experiment with as little delay as possible.

There is nothing miraculous in this dye branch of the science, all that is needed is well grounded research applied in the right direction.

It is a pity the American dye concerns are not

prepared to meet the requirements of this part of the restriction law which reads as follows:

"No dye or intermediate is to be admitted into the country, *unless* the Tariff Commission shall determine that such article or a satisfactory substitute therefore is not obtainable in the U. S. or any of its possessions on reasonable terms as to quality, price, delivery, etc."

The following appeared in one of our New York papers:

England Gets German Dyes

Three Hundred Tons Have Already Been Received

LONDON, Feb. 5.—Great Britain is well ahead of the Allies in obtaining German dyes, of which 300 tons have already reached this country.

The committee of dye users which has gone to Germany under the authority of the Board of Trade to purchase 2,000,000 pounds of dyestuffs includes representatives of the board, as well as expert users engaged in the cotton and woolen textile and the paint and varnish trades. They are ten in number, and will devote a fortnight to selecting the colors most urgently required here. Their purchases will be in addition to the 1,500 tons to which Great Britain is entitled under the reparation clauses of the peace treaty.

From a census of stocks of dyes in Germany it has been ascertained that there were about 22,000 tons, of which 6,500 are due to the Allies. The remainder after the British quota, will be distributed to users in the United States, France, Belgium and Italy.

After all it is the consumer who must pass on the value of our dyed materials, and at present none of the establishments will guarantee fabrics dyed with American colors. In my experience some of these dyes have not only faded but passed away entirely.

The U. S. can certainly make fast dyes. But it is necessary to make the right start in this line as in every other, in order to accomplish the best results. Therefore let us not delay any longer in getting on the proper road. Let us look to the research chemist.

The Carbon Black Industry Surveyed

During 1918 43,500,000 pounds of carbon black were produced in the United States. The production this year will likely be less in West Virginia but will increase in Louisiana.

By Roy O. Neal

Chemical Engineer, Bureau of Mines

THERE seems to be some confusion between the terms carbon black and lampblack, although in American trade lampblack is generally understood to be a soot formed by the smudge process. In this process oil, coal tar, resin or some solid or liquid carbonaceous substance is burned in an insufficient quantity of air, while on the other hand carbon black is a product resulting from the incomplete combustion of gas and is deposited by actual contact of flame upon a metallic surface.

The various carbons, such as gas retort coke, oil retort coke, graphite, carbon black, lampblack, vine black, wood pulp black, willow charcoal, and blacks made from refuse material such as leather have different characteristics as to flocculence, strength of color, and physical structure. These blacks are made by one of the following methods:

(1) Formation by direct contact of a flame upon a depositing surface.

(2) Production by combustion of an oil, tar, etc., in an inadequate supply of air; the soot is allowed to slowly settle out on the floors and the walls of the collecting chambers.

(3) Carbonization of solids and subsequent reduction to a state of small subdivision.

(4) Production by heating carbonaceous vapors or gases to a decomposition temperature by external heating, with or without air in the forming chamber. This is usually referred to as cracking or thermal decomposition.

Each black has its specific use that in most cases can not be met by another black. It is often difficult to apply the usual tests to determine which to use on account of the modification in properties upon combination with other substances. In what follows the black resulting from the incomplete combustion of natural gas is taken up and is designated as carbon black, although often in the trade it is referred to as gas black, natural gas black, ebony black, jet black, hydrocarbon black, satin gloss black, and silicate of carbon.

The estimated production of carbon black for the year 1918 was 43,500,000 pounds, of which 30,000,000 pounds was manufactured in West Virginia, and only 1,500,000 pounds was manufactured in Oklahoma. This year will probably show a decrease in production of West Virginia and a material increase for Louisiana, where a large number of plants have recently been built. In the Monroe, Louisiana, gas field, which is probably the largest in the world today, the gas can be obtained for two cents per thousand cubic feet, whereas in West Virginia the carbon-black operators are paying about three cents. The industry is necessarily a migratory one, and usually finds its home in an isolated district where there is an abundant supply

of gas with insufficient marketing facilities. Judging from plant production, the average yield of carbon black in pounds per thousand cubic feet is probably 0.85 for Louisiana, 1.10 for West Virginia, 1.1 for Oklahoma, and 1.4 for Wyoming.

The estimated distribution of carbon black per annum is:

	Pounds
Rubber industry.....	20,000,000
Printers ink.....	10,000,000
Export	8,000,000
Stove polish.....	4,000,000
Phonograph records.....	500,000
Other uses.....	1,000,000

Under other uses are paint, carbon paper, type ribbon, tarpaulins, carriage cloth, black leather, paper, bookbinders' board, shoe polish, electric composition insulators, celluloid, buttons, etc. At present the export trade is small, pending the establishment of stable basis of credit with Germany and Austria, but considerable quantities are shipped to England, France, Japan and China. During pre-war times one-third of the annual production was exported.

The first carbon black made in 1872 sold for \$2.50 per pound; this price rapidly decreased until it reached the low mark of five cents per pound in 1912. In 1915 support was given the carbon black market when the beneficial results of the use of carbon black in rubber tire making was discovered. The market price of carbon black has increased, and has not since fallen below eight cents. During the past two years it has sold for as much as sixteen cents. The grade of black above mentioned is that used by the rubber and newspaper ink trade, and constitutes the bulk of the production, although there are some grades, such as the Peerless black, that bring as much as thirty-five cents at the present time. The latter is used in limited quantities in making embossing and high grade lithographic ink.

When planning the construction of a carbon-black plant information on the following points should be obtained: Distance from railroad or navigable stream, depth of wells, thickness of gas-bearing strata, gas pressure, gasoline content and knowledge as to whether gas is casing-head or dry, amount of proven territory, history of field, drilling practice, location of field in regard to large centers for domestic and industrial distribution of gas, distance from large trunk pipelines for transportation of gas, open flow capacity of gas wells on prospective leases, and a test on the richness of gas for

the approximate quantity of carbon black that one expects to procure per thousand cubic feet.

The carbon black value is determined either by chemical analysis of the gas or by a test apparatus in which a known quantity of gas is burned and the carbon black that is deposited upon a plate is collected and weighed. By chemical analysis the yield of carbon black is computed from the percentage of ethane, heating value, and the carbon content. Louisiana gas contains 3.44 per cent. ethane, has a heating value of 962, a carbon content of 33.8 pounds per thousand, and only 0.8 of a pound is obtained per thousand cubic feet; whereas Wyoming gas, which contains 43.1 per cent. ethane, has a heating value of 1,176, and a carbon content of 44.3 pounds per thousand, the yield is 1.4 pounds. There are four commercial processes of making carbon black classified according to the quantity of carbon black produced. The order is as follows. Channel, small disc, large plate and roller processes.

Channel Process.

Briefly the channel process is as follows: The gas from the wells is reduced in pressure by suitable regulators, and then goes through gasometers that regulate the flow by a butterfly valve. The gas then passes to the burners in the condensing buildings, special precautions being taken in the pipeline design to obtain equal distribution of gas in all the buildings. The condensing buildings are sheet-iron buildings about 100 feet long, and from 10 to 8 feet in width, arranged in rows along both sides of an alley. Through the center of the alley, and at right angles to the condenser units, is the main driving shaft, which operates the machinery within the units.

On the interior of the buildings are tables of channels, beams having eight 8-inch channels that travel on trucks supported by a trestle 6 feet high and 66 inches wide. The channels have a reciprocating motion of about 55 inches. The gas is burned through ordinary lava tips with an even, luminous, and smoky flame, the draft being regulated by a slide door or slits at the base of the buildings, or by the chimneys. There are about 1,600 tips per building. The carbon black is deposited upon the underside of the channels. Underneath the channels and spaced every four feet are sheet-iron hoppers to catch the carbon removed by scrapers set in the hoppers. Connected to the hoppers is a spiral conveyor that carries the black to the bolting room. The bolters are galvanized sheet-iron drums having a layer of 45 to 60-mesh iron screen held by heavy wire as reinforcement over which fiber brushes rotate; the purpose of the device is to remove grit, scale and like material. From the bolters the product is elevated by an endless chain to a storage bin, whence it is packed in 12½-pound sacks. The ordinary sugar packer with slightly different filling sugar is used.

The plants are usually built in 60-barrel units (50 pounds per barrel), and have 18 buildings. The channels and other moving mechanism weigh about 200 tons. This is actuated by a 20 to 25 h. p. internal combustion gas or expansion engine. The operating cost is about 2 cents per pound (exclusive of cost of gas), and the construction cost at present is about \$2,500 per barrel per day.

Rotating Disc.

The discs are made of cast iron, 36 to 40 inches in diameter, having a 6-inch face, and, together with the gear and pinion, resemble flat umbrellas. The hopper and scraper radiate from the shaft, and, like the burners, are stationary. The burners are in the form of rings with lava tips inserted about the upper part of the ring. The discs are set in rows of 21 each, with four rows to the condensing building, and a separate driving shaft for each row of discs. The pinions are of special design, having teeth about 4 inches wide that mesh with 2-inch teeth on the gear. This arrangement is to take care of expansion and contraction. Other details of the plant are the same as in the channel system.

Plate Process.

The plates upon which the carbon black is deposited are 24 feet in diameter, and made up of 48 segments, which are supported by a central mast and cables. The plates are stationary, while the burners and scraper rotate, making one revolution every eight minutes. There are 1,265 tips to each plate. The plates are surrounded by a circular building 26 feet in diameter, made of corrugated sheet iron. The conveyor system, bolting, and packing process are the same as in the preceding systems. One company has as many as 113 rings and a daily production of 10,000 pounds.

Roller Method.

In the roller process the gas is burned through lava tips, having a round perforation instead of fish tail. The rollers are 8-inch diameter and three feet in length, making one revolution in thirty minutes. The scrapers are set on top of rollers, and scrape continuously. From 6 to 9 rollers are inclosed in one hood. In one plant visited there were 1,150 rollers and 40,000 tips, with a production of only 300 pounds per day. The yield per thousand cubic feet is very small, but the product commands a high price, about 35 cents at present. It is used in making embossing and high grade lithographic inks.

Thermal Decomposition.

Thermal decomposition, or the subjection of oil vapors or gas to cracking temperatures with or without the presence of air, is not a commercial success at present, inasmuch as the resulting carbon is heavy, contains tarry matter, and is off color. A company in western Oklahoma erected a cracking chamber for making black from natural gas, and found that the product was salable. A jobber said

that it was not good for any purpose except perhaps to blacken the face of a minstrel. The process, however, furnishes a promising field for future research. Possibly by using a properly designed cracking chamber, sudden cooling, using some catalyser, employing pressure or the admission of a suitable quantity of air, the process will become a commercial success and capable of producing a black having the same properties possessed by the ordinary carbon black on the market today.

Economics of Carbon Black Industry.

It is generally conceded that the most useful purpose that natural gas can be applied to is for domestic consumption, but whether gas is of greater economic value for the manufacture of carbon black than for other industrial uses is a question that must be decided on the basis of conditions existing in each locality in which a large supply of natural gas is available.

The utilization of low-pressure gas, discharge gas from natural gas gasoline plants, gas in isolated district, and fields which have been abandoned by other gas companies on account of low pressure for the manufacture of carbon black is in reality often a conservation measure and is preferable to the common practice of letting the gas go to waste.

One should be mindful that provision must be made for a sufficient incentive to induce enterprise. Keeping gas in the ground for an indefinite period ties up money and resources in an unremunerative way. If the gas can be produced and yield production of goods to the state and profit to the individual the public benefits accordingly, whereas if the resources are left in the ground where it cannot be used and gives no returns on the investment the loss to the state and to the individual may be gauged by the interest lost during the period of no returns. There is always the question whether it will in the end pay to hold the gas in the ground awaiting an unknown future period when use will give more profit than the present methods of utilization. Obviously, local conditions will be the determining factor.

The utilization of natural gas for domestic consumption is possibly the most beneficial use that can be made of gas, and it is not recommended that gas be used for the manufacture of carbon black where there is an available market for the gas for domestic purposes. The Bureau of Mines favors the use of natural gas in such manner as to give the most public good under the particular conditions surrounding its occurrence.

Ostwald's New Color Laboratory

IN the presence of the Saxon and Dresden authorities, Professor Wilhelm Ostwald, the discoverer of the science of color, recently founded the first laboratory of workshop for the study of colors that the world has seen, according to the December issue of the German paper, *Farbenatlas*. Simultaneously with this event, Professor Ostwald, in the Technical High School of Dresden, lifted the veil hitherto enveloping his discoveries, which are such high importance to industry and trade.

In a lecture on "Color Science in an Hour," he showed the primary colors, black on grey to white in eight shades; the mixed colors, yellow, green, red, violet, cyan-blue, ice-blue, sea-green, and leaf-green, then the centigrade colors, and the limited chromatic circle of the fundamental colors in 24 known tones, the luminous light, the luminous dark, and the turbid colors, as well as the series of colors obtained by admixture of whole colors with the series of mixed colors. When each of the 24 color tones is mixed in increasing strength with each of the eight shades, 24 color triads are thus produced, each of which, besides the black-white series, comprises 28 tones, so that 24×28 equals 672 colors plus 8 shades, all of which arise from the black-white series. Within this number every color which is formed may be graded and classified in its order, by

which means a great advantage ensues for every trade which has to work with colors.

Professor Ostwald related the fact that a Berlin dyestuff concern which had 20,000 dyes in stock could in this way reduce confusing number of colors into their order for the first time. This ordering of colors has a similar value in the silk industry. A second advantage consists in the fact that each of the 680 graded colors can be designated by numbers or letters, so that, for example, an order may be given to a dyestuff concern to send 34 pounds of number 17; in this way mistakes in matching can hardly occur. Furthermore, Professor Ostwald showed the color harmonies. Harmony of color is determined by rule.

Thus we can formulate the simplest instances of the relations between colors when two color tones belonging to a pair of equivalent chromatic circles not directly grouped together are admixed. Each chromatic circle thus yields 252, hence in all, 28×252 equals 7,056 harmonious color pairs. It may easily be seen to what gigantic figures the relations between three or four colors can grow. He concluded by showing the great value of color orders to German industry and trade, since more than one-half of all trades have to do with colors, a fact of considerable importance.

The Utilization of Lignite

SPEAKING on "The Utilization of Lignite" at a recent meeting of the Montreal branch of the Engineering Institute of Canada, Mr. R. de L. French described the steps taken by the Federal Government, particularly through the Lignite Utilization Board with offices in Montreal, to bring lignite into more extended use. Lignite was of immense value to Canada, as most of the coal in that country is of the lignite class.

The largest field is in Souris, Sask., which, it is estimated, contains two billion, three hundred million tons, while the Manitoba field contains 160 million tons. The output of lignite has considerably increased and in 1918 the output of the Souris field was 397,000 tons.

Mr. French then described the work of the Lignite Utilization Board, of which Mr. R. A. Ross is chairman. As the result of the experiments made by the board, Mr. French stated that he saw no in-

superable difficulties to the use of lignite for industrial purposes, and much greater advances had been made in this direction than in its use for domestic purposes. Lignite contains a large percentage of moisture and this has to be paid for as freight, which naturally detracts from its value as a domestic fuel.

The board's experiments were with a view to adapting lignite for use in the ordinary furnace. Mr. Ross had done considerable work in investigating the use of lignite, and his reports were followed by the appointment of the Lignite Utilization Board. Mr. Stansfield and the speaker had visited the various plants in the United States and the former had carried on the investigation as to the carbonization of lignite, although the main idea was not to obtain the by-products, which were not of great value. Attempts to make raw briquettes had failed because there was not sufficient tar in the lignite.

Blue Asbestos to Be Utilized Here

A CIRCUMSTANCE of considerable importance to the asbestos industry has recently been noted in "Asbestos," published by the Secretarial Service, 721 Bulletin Building, Philadelphia, Pa. It is well known that during the years 1915 and 1916 considerable "Cape Blue" asbestos was imported into the United States to supplement the Canadian and Arizona supply. The crude fiber was treated in the same way as Canadian fiber, but in general the product obtained was unsatisfactory. Similar results were obtained when blue asbestos was first used in Europe. In order to overcome the objections of manufacturers, the Cape Asbestos Company, of London, England, the largest producers of blue asbestos, established a spinning plant, and demonstrated that the product is well suited for certain purposes, provided it is properly treated. In

order to build up a reputation for blue fiber in the United States, a new corporation, associated with the Cape Asbestos Company, and known as Asbestos Limited, has recently been chartered under the laws of New Jersey. The offices are at 8 West 40th street, New York City, and the works at Bound Brook, N. J. It is the purpose of this corporation to prepare all crude blue fiber for carding machines by a special process which it is claimed is more satisfactory than methods formerly employed in this country. The prepared fiber will be sold to manufacturers. The establishment of this plant marks an important step in the development of a blue asbestos industry in the United States. While blue asbestos can not be substituted for white fiber for all purposes, it is well adapted for certain uses, and its use would tend to relieve the present shortage.

IN a pamphlet entitled "The Hump Method for the Heat Treatment of Steel," the Leeds & Northrup Co., Philadelphia, describes a new way of hardening steel. Accurate measurement of temperatures and the independent determination of transformation points are rendered unnecessary. The work is heated in an electric furnace in contact with, or near to, a thermocouple. A recording instrument draws upon a large scale chart a curve of the electromotive force developed by the thermocouple. While the work is passing through the transformation or decalcification point, the rise in

temperature is arrested, producing a decided jog or "hump" in the line. The operator allows the work to remain in the furnace a definite number of minutes after this hump appears, and then quenches. The results claimed are entire uniformity of heat treatment, including grain size, hardness and tensile strength, together with freedom from distortion, breakage, decarbonization and scale. In addition, there are certain advantages due to the use of electric furnaces, such as cleanliness, low upkeep charges and ability to locate the heat treating department in the machine shop.

Colloidal Fuel and Its Use

The Nature of Colloidal Fuel, Its Development During the War, Results by Tests, with a Review of Present and Future General Industrial Possibilities

By LINDON W. BATES

Part Two

COLLOIDAL fuel is a composite whose particles are in three states of dispersion—solution, colloid and suspension. They give the characteristics of the three conditions. Some of the particles pass through a filter, many do not. Many are visible and measurable under the microscopic inspection. Others are not. Some show active Brownian movement, others show slower movement, others no such movement at all. In considering the changes and stabilization under the treatment of colloidal fuel, the division of the carbon surfaces must be noted. A cube of coal one centimeter on each side exposes a surface of 6 square centimeters. Such a cube pulverized so that 85 per cent. passes through a 200 mesh screen exposes surface of about 1872 square centimeters. The ratio of surface to volume has multiplied over 300 times. Such a cube reduced to colloidal size (or .1 diameter) develops a surface of 60 square meters—a multiplication of 100,000.

In colloidal fuel most of the carbon particles are not reduced to colloidal sizes. Many remain much above these limits and above the colloidal borderline.

Coming to the study of the manufacture of the fuel, it is highly important that a wise and right selection of the components be first made. A broad latitude, however, exists, which is one of the elements of the economy in the new creation; for virtually all classes of carbons susceptible to pulverization or other manner of reduction to particles are available for combining with liquid hydrocarbons for the creation of colloidal fuel. Anthracite, semi-anthracite, bituminous and semi-bituminous coals, as well as lignites and peats, are usable. Anthracite culm, dust and slush, bituminous and lignite slack, screenings and dust and also coal "seam dirt"—all these of suitable quality—are amenable. To these may be added pressure still, smelting and gas house coke and charcoals. Various grades within these groups have been used. Also certain cellulosic and semi-cellulosic by-products, such as waste from starch, corn and flour factories, wood pulp, wood dust and disintegrated peat and lignite are available. Woods when properly pulverized serve also the cause of colloidal fuel. Carbons of relative high ash and sulphur content may be incorporated. As a result of the pulverizing the colloidalizing treatment, the new fuel when burned does not leave, as with pulverized coal, masses of slag. Most of the ash passes off with the gases, the rest falls

to the bottom of the grate in fine powder. The sulphur content, which is of vital moment to certain industries, can be averaged down by blending the product with liquid hydrocarbon containing proportionally less sulphur. Several kinds of carbons may be used together.

For the manufacture of the new fuel, the coal should be reduced so that about 95 per cent. passes through a 100 per cent. screen and 85 per cent. through a 200 mesh screen. Fine pulverization, which the advantage, is not essential to the process. Coarser particles than those cited above may be temporarily or partly stabilized, serving sufficiently well certain fuel uses. In all coal pulverized to pass through a given screen, it is manifest that many particles are smaller than those which just succeed in passing. A general proportion is observed. For instance, if carbon is so ground that 99.7 per cent. passes a 100 mesh, a 400 mesh screen will be passed through by about 70 per cent. of the coal particles and amounts progressively diminishing would be found to pass finer screens. The treatment of the colloidal fuel does diminish somewhat the size of the coal particles, but in the product many or most of the particles lie well about the colloidal sizes. For the reduction, mechanical, electrical or chemical means may be used, but an ordinary coal pulverizing ball or tube mill is most economical.

Turning to the dispersion medium employed, one finds that all liquid hydrocarbons which are usable as liquid combustibles, whether they mix or do not mix with others, such as oils, tars and pitches, may be used. The fuel has been made successfully with all the liquid hydrocarbons tried. In the list of those tried are various fuel oils, pressure still oil or tar and coal tar, the by-products of coke ovens and of gas houses, and liquified road oils, wax tailings and other hydrocarbons. By "pressure still oil or tar" is meant the residual left from topping and cracking a paraffin base oil in pressure stills. Liquid hydrocarbons of higher sulphur and water content than would otherwise be acceptable can be used for the new fuel, since it is possible to average the sulphur and water in the process of manufacture. Solid hydrocarbons are also available when liquified. Carbonhydrates are included, as hydrogen and carbon are found in them, if when liquified they fall into any of the above-mentioned groups. Several liquid hydrocarbons may be blended.

To carry the load of a high percentage of carbon, the liquid should be approximately a certain viscos-

ity which the treatment secures. While a lower viscosity does not hinder the creation of colloidal fuel, it lessens the load which the liquid hydrocarbon can stably carry. If the product sought is to be a gel or a paste, the initial viscosity is of less concern. If the liquid medium provided is of over high viscosity to produce a liquid fuel with the percentage desired of load, a "cut back" can be introduced to lower viscosity. This "cut back" can be of another suitable hydrocarbon. If the medium provided is of low viscosity, the process is reversed and the viscosity is raised by introducing a liquid hydrocarbon which adjusts the density. Several other ways, of course, exist for securing the right viscosity, such as, for instance, heat and emulsification.

With the right quality of fixateur or peptizing agent stability is most readily and satisfactorily secured through its use. Varying the amount introduced makes adjustment simple. In general, the shorter the time the less the degree of stability desired, the lower the temperature, the less the load and the finer the grinding, so much less fixateur or peptizing agent is needed. If a gel or paste is required, less of the agent is essential than if a liquid is sought. The introduction of more agent than is demanded for liquid stabilizing begets a tendency to early, complete and consistent gellification. The amount of the agent therefore introduced must be a matter of knowledge from experimentation. It must be such a quantity and quality as will secure adequate stability at the temperatures of storage and preheater. In practice, virtually, the maximum of a good quality of fixateur which has ever been employed to secure a stable liquid is an amount which adds 2 per cent. by weight of the essential substance of the fuel. The minimum producing an appreciable result is about .1 per cent. Ordinarily between $\frac{3}{4}$ per cent. and $1\frac{1}{2}$ per cent. is used. Higher percentages of certain peptizers or stabilizers are required. If gaseous means are used these percentages do not hold. Between these outer limits the quality of fixateur and peptizer for particular products has been very accurately determined by experience and the effects recorded of different percentages blended with various ratios and kinds of components of the colloidal fuel.

Some of the experiences in regulating the life of stability deserve record herein. In the first instances given, the carbon was ground so that 97.5 per cent. passed a 100 mesh screen and 95 per cent. passed a 200 mesh screen. In the latter instances, the 99.7 per cent. of the carbon passed a 100 mesh screen, 89 per cent. passed a 200 mesh and 85 per cent. passed a 300 mesh screen. In the first instances, the special gravity of the oil was .924, in the last two .943. The specific gravity of the pressure still oil was .96. Of the coals, the specific gravity of the Pocahontas was 1.39, of the semi-anthracite 1.8, of the coke 1.7. Some ten days stability

was secured in a composite of $40\frac{1}{2}$ per cent. pressure still oil, 3 per cent. wax tailings, 15 per cent. road oils, $1\frac{1}{2}$ per cent. fixateur, 40 per cent. pulverized anthracite coal. Over three months' stabilization has been shown in a composite of $50\frac{1}{2}$ per cent. pressure still oil, 3 per cent. wax tailings, 15 per cent. petroleum pitch, $1\frac{1}{2}$ per cent. fixateur and 30 per cent. coke. Over six months stabilization was recorded in a composite of 3 per cent. middle fraction oils, $\frac{1}{2}$ per cent. fixateur, 5 per cent. coke oven by-products tar, $56\frac{1}{2}$ per cent. pressure still oil and 35 per cent. ground Pocahontas high volatile bituminous coal. About 99 per cent. of particles of coal remained suspended for forty-five days in a composite of 66 per cent. Texas Navy oil, 2 per cent. wood dust, 2 per cent. fixateur and 30 per cent. low volatile and high volatile bituminous coals mixed. In a combination made up of 68 per cent. Texas Navy fuel oil, 1 per cent. fixateur, 1 per cent. wood dust and 30 per cent. coal, 95 per cent. of the coal particles remained in suspension for forty-five days. During the period of stabilization of life of the fuel, rarely does as much as 5 per cent. precipitate. When the period of duration for which the composite is prepared passes, settling begins and slowly progresses. Stability may be renewed in several ways. Ordinarily stirring or heat may suffice or sometimes more fixateur may be required. When after the liquid stability duration passes, a gel is formed, the usability of the product is prolonged, for serviceability is not necessarily forfeited by such densifying. In all these discussions stability is taken as that adequate stability of a liquid which insures suspensions equal to the need and to the simultaneous consumption of components. We are discussing practical industrial economical service—not academic or laboratory experiments. The stability of colloidal fuel is arranged for a temperature of storage between 20 degrees C. and 30 degrees C. At higher temperatures, this blend of fuel has a shorter period of stability, but the manufacturing treatment can usually adjust the composite, as has been said, to such degrees of storage or preheat and length of stabilization as is desired. Even at high preheat temperatures, the particles do not settle with enough rapidity to clog the passage through pipes or other parts of the apparatus. While larger amounts of fixateur, peptizer or stabilizer than the case calls for, and other lesser differences of treatment do affect the product, only in rare cases can this annul the fuel's use. Lesser amounts and less rightful treatment also affect the product, but they merely lessen the degree and duration of the stability or they diminish the density and consistency of the paste or gel.

We turn next to a review of the apparatus needed for the manufacture of colloidal fuel. The first element is a mechanism for suitably pulverizing the coal or other carbonaceous matter and blending the

fuel fixateur and other colloidal components. Existing pulverizing machinery may, with very small modifications, be adapted to serve as a unit. The carbon may be ground apart or the pulverization may go on simultaneously with the treatment instituted for combining it with the liquid medium. Similarly, the fixateur may be prepared apart and in advance, or its components may be united when the fuel constituents are being treated. It may be added to either component separately or to both before combining or after combining. In other words, while the process may be separated and only a final combining be planned, on the other hand, the introduction of new components and the withdrawal of those already treated may occur simultaneously. The process may combine all the functions and treatments and give the finished product, so a continuous process of manufacture may be secured. The apparatus is simple, requires but small area, is relatively inexpensive, so that the item of manufacture cost is not large.

Colloidal fuel carrying up to 40 per cent. of carbon is practically equivalent to the class of heavy oil in relation to handling to the preheater stage. At 20 degrees C. its viscosity will hardly be below 65 degrees Engler, except when only the carbon particles found in pressure still oil are stabilized. The viscosity ordinary will range between 160 degrees and 350 degrees Engler, depending upon the elements and other factors. At higher temperatures that obtain in the preheater, it behaves as do the lighter class of oils. Adding the carbon makes no radical change in the viscosity of the already viscous oils. Colloidal fuel is really only a laden, stabilized oil and the problem of burning both is largely the same. The installations for burning oil, burn liquid colloidal fuel without any material

change. Some slight modification is required for burning the pastes and gels, since there must be sufficient pressure to carry the fuel to the atomizer. If the gel is broken up by pumping, or if it becomes liquid in the preheater, pressure for conveying it alone is needed. Existing mechanical or steam oil burners are adapted to colloidal fuel. Several varieties have been used.

From the point of view of the coal trade, colloidal fuel's arrival is of decided assistance. The waste coal products may be used, and the broken carbonaceous substances increased in utility. Coal can hold a part of the market now invaded by oil, and if pastes are employed it can hold a major part of the choicest markets. From the point of view of the oil industry the advent of the new fuel should not be considered that of a rival, but rather that of an ally. By combining solid carbons with the liquid the fire hazard of oil and the deterioration of oil in storage may be ended through a water seal. Oil may be made available for domestic household uses—a market which oil with its fire hazard now has difficulty in entering. Oil companies will be able to serve more clients if a part of the liquid fuel is made up of carbonaceous substance, and the more clients a concern has the greater is its business advantage. Whereas now it is hard for the oil companies to convince concerns having large coal dumps on hand or contracts in force, to shift to oil, the use of these coals in the liquid fuel will warrant the plants in changing to a liquid basis. These are the broad and substantial advantages of colloidal fuel to the oil industry. The market is so vast that neither solid nor straight oil fuel can gain a monopoly. Colloidal fuel makes of coal and oil "friends, and not enemies," and produces fuel economy.

The British Glass Industry

It is scarcely realized even in England, outside trade circles, the gigantic movement that is afoot to put the British glass industry on a sound and substantial basis in order that it shall be able to make a bold bid for world trade. Within the past few months no fewer than five combines, each relating to a separate section of the industry, have been announced, and it is understood that these are to be followed by at least two others concerning plate and rolled glass and electric bulbs and similar goods.

An example of this consolidation of forces is seen in the formation of the "British Glass Industries, Limited," with an authorized capital of two million sterling in ordinary shares, which embraces twenty-four firms in which the new combine has secured the entire or controlling interest together with immense works in London, Leeds and in all parts of

the United Kingdom, even as far north as Edinburgh, the Scottish capital. This company has already very extensive works approaching completion at Canning Town and Charlton, and has recently acquired the Queensborough Glass Bottle Works, now being largely extended, and also a substantial interest in British Window Glass Co., Limited. With the latest absorptions it is in a predominant position in the United Kingdom. The whole of the works are to be under one central control and direction, this mutually assisting in considerable economies in transport and distribution, the purchase of raw materials, and, equally important, the co-ordination of the work of the highly skilled staffs employed. The wide range of manufactures undertaken by the combine in one or other of its factories includes every description of bottles, electric light bulbs, jars or containers, tubing, bulbs for miners'

lamps, wireless telegraphy and motor headlights, lamp-blown glass ware for scientific, medical, chemical and industrial purposes, soda tubing, illuminating glassware, crystal glass (plain and decorated) table glass and tumblers, window glass, etc.

The salvation of the industry, it is recognized, however, depends very largely upon mass production, toward which in the past British workmen have always turned the cold shoulder, clinging pertinaciously to the old-fashioned hand methods and relying upon the extra quality of their work and generally playing the part of under dog to the more enterprising foreign competitor. But we are witnessing a great change. Machines are being introduced in large numbers; in fact, to such an extent that, it is hoped, when the new installations are complete the output will be made ample to meet domestic requirements, after which a united endeavor is to be made to capture those foreign markets which in glass goods were in pre-war days the almost exclusive possession of late enemy countries.

It is, of course, a well known fact that the adoption of the Owens machine for making bottles (an American invention) by Germany gave that country a long lead over the United Kingdom and enabled German manufacturers to dump their products in England at a price that British manufacturers could not compete with. As a fact, only five Owen machines were installed in Great Britain before the war. At the end of last year that number had increased to ten, in addition to which fifteen more were on order and should soon be in working order. This will make a very substantial advance in capacity, which, taking the entire manufacture of glass bottles in the United Kingdom by all methods into account, will give a capacity for production five times what is was before the war. Formerly the estimated capacity of the members of the Association of Glass Bottle Manufacturers, which covers 90 per cent. of the trade, was 480,000,000 bottles per annum, and the British Glass Bottle Manufacturers, Ltd., who acquired the sole rights over the Owens machine twelve years ago, have increased their output to 320,000,000 bottles. The English and Scottish Glass Bottle Manufacturers' Association have also increased their production during the war period, the present output being 80,000,000 bottles, a total which it is expected will be doubled by the end of the summer.

In other sections production is increasing at a considerable rate, thanks to the general adoption of machinery. Electric lamp bulbs are now being produced by the million compared with the thousand a little while ago. Here again it is recognized that volume of output is the determining factor in cost of production, and that unless British manufacturers go wholeheartedly in for mass production it will be impossible for them to produce lamps at costs comparable with those of American, German and

Dutch makers. British manufacturers hardly expect, under conditions at present ruling, to be able for some time to come to approximate to the low cost of production in the United States or Germany owing to the smaller population and, necessarily, the smaller consumptive demand. But they have hopes, founded upon the fact that already the productive capacity of the factories at present is sufficient to about fully meet the home demand and the determination to put in further new machinery to create a surplus for the foreign trade. No reliable statement as to the present production is available, but it is interesting to state that just before the outbreak of war the output of bulbs had risen from eight to about twenty-five million and was beginning to seriously compete with the large German companies in the neutral markets of the world. It is estimated that the British lamp industry could easily give employment to another 15,000 or 20,000 workpeople were the Government to give some measure of protection from unfair competition.

Great headway is also being made with the manufacture of oil lamp chimneys, the output of which is expected soon to reach 100,000 per week, which is regarded as a wonderful achievement in view of the fact that before the war all these articles required for English use were imported from Germany.

The manufacture of window or sheet glass is also developing enormously, in which product very great possibilities are centered. During the past year Britain has had to rely very largely upon Belgium for this article, an average of four ships fully laden with sheet glass arriving per week at the London docks. One English factory recently opened at a cost of £100,000 is capable of producing 10,000,000 square feet per annum, and its manager asserts that his firm can produce it at 40 per cent. less than the Belgians can. An interesting fact in connection with this concern is that 25 per cent. of the workmen employed are Belgians (including the manager himself), and that they are training British apprentices to the work. These boys start at 10d per hour. Skilled glassblowers on piece work and with an eight-hour day can earn £12 to £16 per week.

Remarkable progress has also been made in the optical glass industry. Thanks to Government aid this factory was extended and another built during the war, and Britain is now producing on a very big scale lenses, etc., equal to anything produced elsewhere in the world. When the armistice was signed Britain was manufacturing an amount of optical glass equal to about twice the world's peace consumption. It is contemplated that if the British manufacturers show as much enterprise in the next few years as they have shown in the past five years there is every reason to say that by then Britain will have established a leading position in the world for its manufacture.

The Spring Meeting of the A. C. S.

Reflective of the spirit of the times, the meetings of all the sections in St. Louis were extremely practical in nature. A number of announcements were made which were of great importance to several chemical industries. 1

A chronological account of the spring meeting of the American Chemical Society would require more space than we can in these days of paper scarcity afford. In order that our readers might, however, gain some appreciation of the importance of the meeting to technical and business men alike Dr. Olsen was delegated to attend the meeting and make a selection of papers which, when printed, would at least reflect the "high lights" of the gathering.

That the meeting was a success from the point of view of the society, there is no question; that it was a success from the point of view of the man who would see the chemist play a larger part in industry, only a reading of the following papers and abstracts will prove.—Editor.

THE industry of making potash and other chemicals from the kelp, a seaweed which grows along the Pacific Coast in large quantities, can be made profitable, according to Dr. J. W. Turrentine, of the United States Department of Agriculture, who addressed the Section of Industrial & Engineering Chemistry of the American Chemical Society on April 15th.

Dr. Turrentine is in charge of an experimental plant at Summerland, California, which was founded for the purpose of ascertaining if an American potash industry could be based on the giant seaweed as raw material. He said that it can if one takes into consideration the valuable by-products associated with the potash. Before the war American agriculture was largely dependent upon Germany for the potash used as fertilizer and in the industrial arts.

"This plant," said Dr. Turrentine, "has been from the beginning and of necessity is a producing plant, since only by producing potash can the cost of production be determined. Its initial products were the simplest that could be produced from kelp, and these have been produced steadily while refinements and elaboration of processes have been worked out and instituted. With refinements it was possible to separate the various products yielded from kelp and to determine the commercial value of each. It was soon established that potash alone at former prices could not pay the operating expenses of a kelp-potash plant, although this could probably be done at present prices for potash. It was seen that by-products would have to be gotten and sold to help pay the cost of producing potash; and the production of by-products has been the main problem of this governmental enterprise.

"To date, about thirty products, by-products and derivatives have been established as obtainable from kelp when processed in the manner in vogue here.

Some of these have commercial value and some have little or none. Some are obtainable in large quantity and cheaply, while the production of others probably will not pay more than the expense of that operation. Among the products are such materials as potash and various salts of potash, table salt, crystalline iodine and various salts of iodine, ammonia in various forms, bleaching carbons of various grades, oils of different characteristics and degrees of usefulness, creosote and disinfectants and other derivatives prepared from it, pitch, prussian blue and combustible gas; and of these potash salts, iodine bleaching carbons, ammonia, oils and combustible gas are obtainable profitably. However, to date only potash, iodine and bleaching carbons have been put on the commercial basis and soon are to be produced on the large scale as a part of the daily operation of the plant. The potash obtained is in the form of a high-grade potassium chloride, which is a white crystalline material, resembling sugar, and with a taste similar to that of the familiar potash throat gargle. The iodine is yielded in the form of crystalline, sublimed iodine of high purity, which in that shape is a gray, sparkling crystalline material, and only needs to be dissolved in alcohol to produce the familiar tincture of iodine. The bleaching carbon is a black, uninteresting-looking material, but has a value twice that of potash on the basis of possible daily output, and is used in taking the color out of various sorts of things, principally food products which cannot be bleached with chemicals. Thus it is of great value in industries where sugars and syrups are manufactured, particularly the new industry of malt syrup manufacturing which has grown up on the defunct brewing and distilling industry, and in bleaching edible oils, glycerine, organic acid, such as those manufactured from waste lemons and oranges, and similar materials. It is in great demand as taking the place of a carbon formerly imported from Europe and sold at a very high price.

"Thus, three products, potash, iodine and bleaching carbon, for which America is now dependent on foreign countries, are now being produced from kelp. This dependence will be entirely wiped out with respect to iodine and bleaching carbon, and certainly at least impaired with respect to potash. With these three products obtained from kelp and yielded in such quantity as economical processing admits, the kelp-potash industry can be put on a substantially profitable basis.

Further Dye Research Needed

The need for research in the dye industry was discussed by Dr. Robert E. Rose of the E. I. du Pont de Nemours Company, in a paper read before the Dye Section, on April 14th. In part Dr. Rose said:

"We are very certain that this country possesses the materials and men to assure the success of the dye industry. We have the raw materials for all that is necessary; our chemists have shown that they can convert these into very excellent finished products; but, granting this, it still remains true that we have a long way to go before our resources are put to the best use. As a whole, our dye industry is rather like a process which is past the semi-works stage but is not yet a smooth running plant operation. It is for us to do all that we can to realize what is yet needed and to put every effort into making those things which we see are necessary, a part of the industry.

"For my present purpose, I wish to point out that we are as yet digging up treasures fashioned and hidden by others. We have yet to hear that an American house has produced an entirely original and very valuable contribution to the list of commercial dyes. We have yet to read papers embodying the successful results of academic research which open new fields for the industrial dye chemist.

"Is it too early to think of doing all that may be, to speed the time when American names will be mentioned as originators in our chosen field? I do not think so, and I am here to tell you what I think should be attempted in order to insure our future.

"Research we must have—not a mere checking up of recipes, not a mere search for information which is known to others, but not to ourselves—that type of work has been exaggerated out of all semblance to its real value simply because of the fact that we have had to start with hardly any knowledge of this particular Chemical Industry and we have been going through a sort of undergraduate course in dye chemistry. No, that is not what will keep us ahead—we must graduate to real research, that is, enter the entirely unknown, and either apply known generalization to new cases, or—and this is the higher faculty—taking known facts, add to them, and then generalize in such a way that new ranks of facts stand at our command. Of these two types of research, as I see it, one falls within the province of industrial organizations, the other almost exclusively to academic thinkers, using the word 'academic' to denote any investigational activity which is not prompted by immediate utilitarian motives.

"If my assumption is correct, it is clear that we, who must make research pay its way, are vitally interested in fostering that research which, though in reality more production, is not so evidently based

on financial returns. No one can tell a research chemist outside of the industry what he should study. The very essence of academic research is absolute freedom, even from the bias which comes from industrialism, and it is almost impossible for the sense of an industrial organism to see with unbiased eyes. But, on the other hand, the highest theoretical achievements have always come from a close attention to facts. Let us then furnish the facts and let the academician use those in any way he sees fit. We should then draw his attention to the subject, hardly more than that.

"Here we come to the first apparent stumbling block to that very necessary co-operation between those occupied in pure science and those who produce according to the methods of science: This is industrial secrecy—a very dangerous weapon because it is not alone two-edged, but double pointed. All I can say is, that I hope the day may come when secrecy is no longer a necessity. In the meantime, we must admit that it must be observed. I should like to see it mitigated in this way, at least, that any real research chemist who is doing important academic work should have access to any and all industrial plants and to the methods followed in those plants, he being on his word of honor not to divulge any secret process, but simply to utilize the information to the advantage of his research or of his knowledge of the subject in general. I believe this scheme was followed in Germany, where every Geheimer Hofrat was given the privilege by law, and where, so far as I know, that privilege was never once abused, though it conducted materially to keeping the universities seats of live learning abreast of the times instead of years behind.

"In order to keep our subject before the research men and women of the country I think that we, in the industry, should lose no opportunity of emphasizing the theoretical side of our subject in public by addressing meetings of research men, writing articles, and, if possible, when we know enough about our subject, by writing textbooks or assisting those who wish to do so. You will find, if you think the matter over, that you can discuss most of the theory, even of your most secret processes, without risk of betraying your secret—why not do so instead of getting the schoolman to tell us of the theory apart from our special need?

"More than one of the large companies have instituted a system of Fellowships and Scholarships to keep the subject before the institutions of learning of the country. That is going to help materially, but I have a warning to sound—We must discourage the doing of sporadic work, the making of a color by some novel way. What the universities should do is to contribute to our understanding of the theory and that they cannot do by building new colored bodies which are very unlikely to succeed as commercial products. The danger is that the problems will be just such as occur to the re-

search chemist in the industry who wonders what would be the result of combining atoms in a new order, but cannot take the time to satisfy his curiosity. The reason why this type of problem will be overdone is that a great many of the men who are in charge of organic work are by no means dye chemists, make no claim to be such, yet they feel that it is only fair to let a student, holding a fellowship given by dye manufacturers, attach a dye problem—they then ask for suggestions and those are given them. What is required is the broadening of our knowledge of the fundamental theories of organic chemistry, and this can be better achieved by systematic work in any chapter of the chemistry of carbon than by the making of odd compounds fashioned on the fancies of the student of applied science.

"Just as we do not feel that universities and colleges should attempt technical courses, but train in a knowledge and understanding of the subject, so we wish the contribution of the workers in pure research to be basic. A series of investigations carried out in a logical effort to reach a generalization, that is the type of work that will most benefit the dye industry of this country.

"Raw products, money, commercial organization, industrial chemists, all these we may have and yet fail if we have not real research."

Dyes of a "vivid green" as well as the brown and blue vat dyes are the latest properties discovered in the corn cob, according to Dr. K. P. Monroe, of the United States Bureau of Chemistry. It recently has been discovered, he amplified, that furfural, a rare and expensive chemical used as the base of some dyes, can be obtained by boiling the cobs in sodium phosphate. By the process, he said, the price of furfural, \$17 a pound, can be reduced to 15 cents.

Dr. Charles L. Reese, chairman, in his opening address to the division, said that in the last year the flow of capital to new ventures in chemical commerce had not been rapid, but that it was a healthy rather than an unhealthy symptom.

"The significant feature of this is that much has been done to put the industry on a sound basis and to safeguard the investment already made," he said. "There has been, however, considerable reluctance on the part of those in charge of the finances of the industry to make additional investments when the money was needed for the proper development of projects already under way, on account of the lack of accomplished legislation to protect this young key industry.

Dr. Reese drew attention to the resolution adopted by the council of the society on Monday night, urging the passage of the Longworth bill.

"Legislation," he continued, "of the utmost importance to the dye industry is under consideration. It is quite clear that the young industry must have protection. That is agreed to by nearly every one,

but the means of attaining the end has been the subject of much debate.

"It seems certain that adequate protection will be forthcoming, and that a law will be enacted which will insure a far more satisfactory tariff than has ever before been in effect, one which has been formulated with the constant advice of experts.

"In addition, we may hope for an embargo for the next three years. It is a pity that action has been delayed so long. Even though the delay may have been justified, yet it has acted as a powerful deterrent to the erection of plants necessary for the proper expansion of the industry."

Problems of Solubility

IN a paper read today (April 13) at the St. Louis meeting of the American Chemical Society, Dr. Joel H. Hildebrand gave the following clear and comprehensive statement relating to the subject of solubility:

"The great importance of the problem of solubility," said Dr. Hildebrand, "has been recognized ever since the days when the first alchemists sought a universal solvent. It is true that we have become somewhat less ambitious, or perhaps somewhat wiser, because we realize not only the unlikelihood of success in such a quest, but also the difficulty which seems not to have occurred to the alchemists of finding a container in which one could keep a universal solvent. But the chemist still works largely with solutions. His methods of analysis depend almost wholly upon precipitation and resolution and his education consists, to a very large extent, in learning solubilities of substances.

"Although this is true, it is also unfortunately true that there are few properties more difficult to predict than solubility. How many chemists are there who would dare to predict which of two newly discovered salts would be more soluble in water or whether the 'mustard gas,' used during the war, would be miscible in all proportions with gasoline or whether phosphorus would be more soluble in benzene or in chloroform?

"The writer felt many years ago that the scant progress made in the theory of solutions has been due largely to the fact that aqueous solutions, because of their great practical interest, have occupied the attention of chemists to the exclusion of nearly all others, and aqueous solutions are probably the most complicated of all because of the prevalence of dissociation and hydration and because water itself contains several species of molecules. Since it is always important in the development of a theory to proceed from the simplest cases, attention has been focused by the writer principally upon non-aqueous solutions. It is possible to report an amount of progress in this direction sufficient to

justify a feeling of confidence that the foundation has been laid for a satisfactory treatment of the theory of solubility.

"Most teachers of chemistry seem to think that osmotic pressure offers the only valid foundation for deriving the various laws having to do with solutions. The writer has chosen rather to proceed from a purely statistical law discovered by Raoult. This law states that in a liquid mixture of two kinds of molecules, each molecule will have the same tendency to escape into the solid or vapor state that it would have if the liquid were composed entirely of molecules of its own kind. In mixtures obeying this law it is possible to calculate the solubility of either substance in the mixture whether it be in the gaseous or solid form. We may say qualitatively that the higher the boiling point or critical temperature of a gas the less soluble it will be in any solvent; also that the higher the melting point of a solid the less soluble it will be in any solvent. Both of these statements follow from the idea that the process of solution consists in liquefaction and the farther the substance is removed from the liquid state the more difficult it is to liquify it.

Now although physical chemists have been familiar with these principles for a long time, it has not been possible to state in advance what molecules would be sufficiently alike to behave in the ideal manner postulated by Raoult's law. We find that molecules may be very different in chemical composition and still be sufficiently alike to obey Raoult's law. It has, therefore, been necessary to search for properties which would furnish a true measure of the degree of similarity of different kinds of molecules so far as concerns attractive forces between them. This search has been successful and we are able to announce that by the aid of readily accessible data such as densities, boiling points, heats of vaporization, surface tensions, it has been possible to arrange substances according to their 'internal pressures' in a table in which the rear neighbors are sufficiently alike to obey Raoult's law very closely, and hence to show solubilities agreeing with the calculations of solubility it is possible to make on the basis of Raoult's law. On the other hand, the farther apart in the table the substances considered, the more unlike are their molecules in the sense of the attractive forces existing between them, and the less soluble they are in each other. Thus a substance at the bottom of the table would be less and less soluble as we proceed to solvents higher up. Almost without exception, the solubility data available agree with this generalization, and a number of predictions were made that have since been abundantly verified.

This paper was the cause of considerable discussion during the course of the session which followed. Opinion was about equally divided among those present in regard to the theories set forth.

Wood Alcohol

Even in the days of prohibition, wood alcohol is so dangerous that Dr. Charles Baskerville, professor of chemistry at the College of the City of New York, suggested on April 5th, that the name of the liquid be changed to the Committee on Occupational Diseases in the Chemical Trades.

"Stress laid upon the mere matter of a name," said Dr. Baskerville, "may appear quite trivial, but there are strong reasons for considering it. The facts of names and their meanings can scarcely be known by all medical and pharmaceutical men. They are even less known to the man-in-the-street. The layman knows that alcohol is the stuff which makes drunk come; that it is the stuff that cheers the down-hearted; that, uncontrolled, it has been a curse in the world; that it is the real thing in the disguise of beer or light wine, which formerly rested him when the arduous day's work was done.

"Therefore it shall be the purpose of some influential chemist and of the powers that be, in the transmission of chemical terms in the English language to see to it that the word 'alcohol' ceases its present significant use, at least in chemical literature. This movement is already under way, as producers in this country of 90% of the refined methyl hydroxide, popularly known as wood alcohol, have decided that hereafter all packages containing it shall be labeled 'methanol' and so their advertisements read in the trade journals this day.

"Data collected prior to 1918," he said, "indicated that the drinking of liquids containing methyl hydroxide was responsible for many deaths and acute cases of blindness. The 'deodorized' methanol resembles pure ethanol so closely, that the ordinary layman can hardly distinguish the difference between the two. In complex mixtures, whiskey, etc., its detection involves very careful chemical analysis. Formerly it cost less than ethanol, so unscrupulous people were tempted to use it as substitute for ethanol in adulterating whiskey, essences, extracts, bitters, washes, liniments, balsams, perfumes, etc. The victims were generally those who indulged in the commoner forms of whiskey, rum, and wine, although persons not addicted to the use of intoxicating drinks were undoubtedly often affected innocently from drinking Jamaica ginger, lemon extract, essences, bitters, medicines, etc., whose chief menstruum was 'deodorized' wood alcohol. At one time the poorer negroes in the Southwest drank it under the name of 'white horse,' or 'old mule.' The price at which it sells now will reduce that danger to a minimum.

"Happily the abuses grew less through the operation of the National Pure Food and Drugs Act of June, 1906. However, death occurred, as stated in

other papers, through the drinking of wood alcohol or denatured alcohol.

"The problem of wood alcohol is not a matter of humanity."

Food Chemistry

Papers indicating new sources of proteins were read. Dr. Johns reported experiments showing that the soya and mung beans produced full growth in animals, while the navy and lima beans of the United States, although they sustained strength, did not promote growth in animals or men. He advocated American cultivation of Oriental beans.

Dr. George Defren, of Newton, Mass., reported improved processes for the manufacture of synthetic lactic acid, now much needed on account of heavy demand from manufacturers of soft drinks and candy.

Prohibition has brought about great improvements in the manufacture of lactic acid, found in sour milk, and now extensively used in popular soft drinks and "almost beers." The details of the improvements were explained by Dr. Defren in addressing the Division of Agriculture and Food Chemistry, as follows:

"Within a year remarkable improvements have been made in refining the oldest known acid in the world; that is, lactic acid, generally recognized as the acid developing when milk sours.

"Metchnikoff, the noted scientist, some years ago popularized the *bulgaricus bacillus*, which produces lactic acid in the human system, by calling attention to the fact that many of the people of the Balkan States attained unusually old age. He claimed that their long life was due to the lactic acid produced from milk and milk products, like cheese, etc., which these hardy mountain people consumed in large quantities.

"It has been the aim of many chemists during the ages to produce this valuable lactic acid in commercial form at a low price, and it is only recently that it has been done successfully. While the crude lactic acid has had commercial application for years in the tanning and mill industries, the refined acid as a food product is only slowly coming into popular appreciation.

"Large quantities of edible lactic acid have been used during the past year to give low alcohol or near-beers a better flavor and to make them acceptable to popular taste. Its use has been extended to ginger ale, root beer, soda waters, etc., also to replace the so-called acid phosphates at the soda fountains. It is receiving application in the baking industry, improving the quality of bread, and has possibilities as a substitute for cream of tartar in the manufacture of baking powders.

"It has been found that the addition of a small

amount of lactic acid to many fruit juices is of great value in causing them to 'jell' where ordinarily they would simply remain liquid when concentrated. Lactic acid is also useful in the candy industry, where it is finding application in giving some types of candy a tart taste, and also to prevent recrystallization of the cane sugar used to make the centers in 'chocolate creams' so-called.

"Lactic acid is beginning to replace ordinary cider and malt vinegar in many industries where these have been used exclusively. As it is as healthful as ordinary vinegar, there is no reason why edible lactic acid should not receive wider appreciation in that type of food.

"Lactic acid has been used in clarifying some types of gelatines for human consumption and has been found to be of great value in the preservation of fish and meat products, especially in canned goods."

The Rubber Section

A new invention for determining the life of rubber products, notably automobile tires, was described in a paper by the only woman member of the rubber section of the society—Miss Irene C. Diner, 25 years old, a student in New York University who also advanced an entirely new theory of vulcanization and of elasticity, and appeared to explain certain phenomena in the structure of rubber hitherto regarded as mysterious.

Miss Diner's invention is said to make it possible to foretell much more accurately and surely than heretofore by microscopic examinations and search for certain wearing qualities, which she discovered, the actual miles any automobile tire may be expected to travel. She is the daughter of the Professor of Chemistry in Fordham University, New York, and is a graduate of Columbia University.

Dr. Henry J. Masson, department of industrial chemistry, New York University, read a paper describing new methods for microscopic examination of rubber, which experts consider will revolutionize testing methods and in view of keen competition in automobile tire industry is regarded of the highest commercial importance.

The Sugar Section

The chemists attributed the high cost of sugar to failure of the beet sugar crops of France, Belgium, Germany and Russia in 1918, and said experiments to obtain a sugar substitute are being conducted with malt syrup.

Before the sugar section Dr. S. J. Osborn reported that the acreage in sugar beets had been increased

about 25 per cent. and that several new factories were about to be opened in Colorado and Nebraska. Better prices are being offered to the beet farmers, who are now sowing their land, and the industry, which has been more or less at a standstill since the beginning of the European war, is now likely to develop. He declared that owing to the perfect chemical control exercised over its important by-products were now being obtained from the industry, such as potash and cattle feed.

Chlorine gas may come into universal use as an influenza preventive. At a conference of the biological section on Wednesday, members said initial tests during the recent epidemic tended strongly to bear out their theory, but they agreed that the rapid decrease in the number of influenza cases did not permit conclusive investigations.

The most extensive tests, it was said, were conducted at the University of Arkansas by Dr. Harrison Hale, head of the department of chemistry there. Eight hundred treatments were administered

to 184 volunteers, who remained five minutes daily in a room containing a small amount of gas. Only one of them developed influenza, it was said, and in that instance, it was believed, the disease previously had been contracted.

Colloid Chemistry

John Arthur Wilson read a paper on "Vegetable Tanning as a Colloid Chemical Process" which created a sensation among the leather chemists present, because it is regarded as opening up a new and more efficient method of testing the materials to be employed in tanning. He declared that it is from 50 to 100 per cent. more efficient than any methods now in vogue among leather laboratories.

Experts believe that it will tend to surer results in tanning and the production of better leather, and possibly will lower the price of the product by the elimination of waste.

Demand New Conservation Policy

THE concluding sessions of the convention of the Paper and Pulp Association held at the Waldor-Astoria, New York City, were marked by the adoption of resolutions outlinging a national forestry policy, which if followed will insure the future supply of the raw materials of the paper industry.

Particular interest and significance were attached to this action in consequence of a special letter from the Federal Department of Agriculture, in which it was stated that the paper industry of America was threatened with extinction unless adequate constructive measures were at once adopted.

The Federal appropriations recommended by the association as adequate to carry out the desired forestry program total \$6,000,000, an amount described as "exceedingly moderate in view of the magnitude of the problem to be solved."

This recommendation carries the provision that payment of \$4,000,000 of the above amount shall be contingent upon an additional \$4,000,000 provided by the States.

The items recommended are:

1. A permanent annual appropriation of \$1,000,000 for forest protection, care and management, and distribution of forest planting material, to be applied only where the States co-operate.
2. An annual appropriation of \$500,000 to continue as long as necessary to make a complete and accurate forest survey and land classification, to determine what lands are suitable for timber growing.
3. A permanent annual appropriation of \$1,000,000 to acquire land suitable only for timber growing,

in all parts of the country where areas adapted to Federal management can be obtained.

4. To better block up the Federal Forest holdings, until their total is 200,000,000 acres.

5. A permanent annual appropriation of \$1,000,000 for forest planting operations in the national forests upon lands adapted to timber growing, and not productive through natural agencies.

6. A permanent appropriation for forest research and investigation, as the information secured will yield a greater return to wood using industries than the expense involved.

7. The extension of the Federal farm loan act to include loans for not over 50 years, for the employment of measures designed to promote timber growth, such loans to obligate the owner to retain the land in growing timber and to protect it under definite standards of silvicultural management.

The committee also proposed State legislation to assist in this general program, declaring that if it is fundamental that agricultural lands shall share in the support of the State, and be aided by the State, it is equally fundamental that the forest land shall bear its share, and that the State should develop all lands suitable for forest planting.

Legislation to this purpose is recommended along these lines, including particularly the following provisions:

The establishment of State conservation commissions, subdivided into departments of forests, waters, and fish and game, each in charge of a qualified chief.

That land be so classified by the State that the forests necessary for the protection of water supply,

or of slopes of hills and mountains, be acquired and set aside as parks, dedicated to recreation and to the protection of the wild life of the forest. Remaining forest lands to be utilized both for direct returns from timber and indirect returns from game and recreation.

The officers of the association for the coming year were re-elected as follows: president, Geo. W. Sisson, Potsdam, N. Y.; vice president, Frank L. Stevens, North Hoosick, N. Y.; second vice president, A. H. Nevins, West Carrollton, Ohio.

It developed during the discussion that during the year 1919 American consumption of paper exceeded the output by about 300 per cent. In consequence, reserve stocks are said to be almost entirely exhausted, the total stocks on hand to date being the lowest which the country has experienced in many years.

Last year's output of the mills amounted to 1,690,361 tons of paper of all types. These production figures pale into insignificance when compared to the consumption figures, which total 6,225,904 tons. The news print production for last year was reported to have been 1,374,000 tons, a subnormal figure.

The discussions from the floor during the closing sessions which were offered on this phase of the situation indicated that the paper manufacturers attribute the unfavorable production record to the consequences of overinterference on the part of governmental agencies. Rigid restrictions, coupled with the general uncertainties typical of all business, is said to have discouraged the flow of capital into the industry, retarded productive effort and in consequence lessened the output.

In our foreign trade during the past year paper has figured but little either in exports or imports. "The world is calling for paper and paper products," said one manufacturer, "and we stand utterly helpless owing to the disorganized home conditions to respond to the call."

Labor difficulties held a large place in the undercurrents of discussion, and to them especial atten-

tion was given in the address of George K. Gibson of the Warsaw Sulphite Fibre Company, the newly elected president of the Salesmen's Association of the Paper Industry.

Mr. Gibson attributed much of the prevalent labor unrest to the general ignorance of the public and of the workingman in the fundamental principles of economics. For the most part, he said, they are totally unacquainted with the laws which govern wages and prices and the flow of capital. In consequence, they seem to assume that all that is necessary to solve their problems is arbitrary action. As is to be expected, they fall easy victims in many cases to the vicious radicalism that is preached on all sides. He advocated that the problem should be met by a campaign of education which should give a better appreciation of the fundamental limitations in industry. Such a campaign to be successful, he thought, must have the sympathetic co-operation of the best elements of labor and of capital.

In the course of the closing day the announcement was made and received with great gratification that the threatened strike in the paper industry has been averted.

Elections were held by three of the paper associations on April 15th. The Technical Association elected for president Raymond S. Hatch, of the Hammersley Manufacturing Company, Garfield, N. J.; vice president, Robert B. Wolf, of New York city; secretary-treasurer, Thomas J. Keenan, of New York.

The Salesmen's Association of the Paper Industry elected for president George K. Gibson, of the Warsaw Sulphite Fibre Company; vice president, F. W. Mains, of the Worthy Paper Company; secretary-treasurer, Dr. Hugh Baker, who is also secretary of the American Paper & Pulp Association.

William H. Schuart, of Springfield, Mass., was elected president of the Glazed and Fancy Paper Manufacturers' Association; Normal Fowler, of Springfield, Mass., and Frank O. Walther, of New York, where chosen vice presidents, and G. Frank Merriam of New York, was elected treasurer.

Dorr Company Reorganizes

THE Dorr Company, engineers, of 101 Park avenue, New York City, has recently arranged for the separation of its domestic sewage and trade waste from its industrial activities by organizing a sanitary engineering department. All matters, including engineering service, pertaining to treatment of domestic sewage, waste waters of tanneries, glue, gelatine, milk products and corn products factories; cotton, silk and textile dyeing and finishing mills, canneries, brass, steel and rolling mills, paper mills, etc., are now being handled by the

sanitary engineering department, in addition as well.

Colonel I. L. Reeves, C. E., formerly president of Norwich University, and more recently president of the A. E. F. University of France, has resigned from the army to accept the management of the department. Mr. C. Lee Peck industrial engineer, continues in charge of the research and development work, while Mr. R. H. Eagles, also of the Dorr Company staff, will assume charge of the information and extension division, a recently organized service department.

Mainly About Companies

The United Mercantile Company, Inc., of New York, of which Mason Harker is president, will liquidate its affairs in New York, the business having been consolidated with the Charles F. Garrigues Company of 54 Wall street, New York. Mr. Harker, formerly president of the United Mercantile Company, Inc., will enter the organization of Charles F. Garrigues Company as general manager with headquarters at Chicago, taking office immediately. William H. Campbell, president of Charles F. Garrigues Company, is leaving for the Pacific Coast to reorganize the San Francisco office and to enlarge the facilities of that particular branch.

Atlas Manufacturing Company, drugs, etc., has been incorporated by George T. O'Donnell, Edward A. Knight, Joseph O'Donnell, Scranton, Pa.

Duane Chemical Corporation of Manhattan has been incorporated with a capital of \$210,000 by A. E. Winter, F. B. Ross, A. H. Skillin, 36 Broad street.

There are large deposits of high grade talc near Tashih Chiao, South Manchuria, China. The crude material can be delivered at the dock ready for shipment in bulk, it is stated, at about \$7.25 per ton.

Taylor Co., makers of hair tonic, has been incorporated under the laws of Delaware with a capital of \$50,000. Incorporators John J. Taylor, H. A. Cotton, Springfield, Mass.; Wesley Kibbs, Somers, Conn.

Plans for the establishment of a paint factory in Shanghai by an American firm have been announced in the China press. This company will specialize in underwater, barnacle-proof paints and intends to make a campaign in the Far East for their dissemination.

The capitalization of the Kentucky Glycerine Company, a Delaware corporation, has been increased from \$100,000 to \$400,000.

It is reported from Wilmington, Calif., that the California Barium & Chemical Co. is about to erect a plant in that city, at a cost of approximately \$100,000 for the manufacture of various products. It will occupy a six acre site, with four furnaces. The new smelter, it is said, will be one of the largest on the Pacific Coast, giving employment to about 100 men.

The Geo. S. Coyne Chemical Co., Inc., has acquired the business of the Geo. S. Coyne Estate, Philadelphia, Pa., which will be continued at the same address, 108 Walnut street.

The Atlantic Dyestuff Co. of Boston, Mass., has purchased from the Emergency Fleet Corporation the Newington shipyard, on the Piscataqua River, just outside of Portsmouth, N. H. Here a modern dyestuff factory will be built, upon whose work already has been started, for the production of sulphur and azo colors, various intermediates and coal tar specialties.

It is reported that the Newport Chemical Works, Inc., is negotiating for a site in Belleville, N. J., for the erection of a branch factory to cost \$200,000.

George H. Lincks, formerly with William H. Scheel, New York, announces that he is now engaged in business for himself, at 106 Wall street, New York, as exporter, importer and dealer in chemicals, oils, gums, waxes, dry colors, rubber substitutes, etc., and specializing in raw materials for varnish, paint, printing ink, rubber goods and fireworks manufacturers.

Recent realty purchases adjoining a previously acquired building site by the Fisk Rubber Co., New York, gives this concern possession of an entire block front on 57th Street bounded by Broadway and Eighth avenue for its projected 24-story building. Land and construction work when completed will represent an investment of about \$4,000,000.

The General Electric Company has acquired under a lease, with an option of purchase, the plant of the Remington Arms-Union Metallic Cartridge Co. in Bridgeport, Conn. The property, with extensive trackage facilities, include 40 acres, 20 of which are now covered by buildings with a combined floor area of more than a million and a half square feet.

D. Van Nostrand Company, technical book publishers, New York City, will remove their offices and sales departments May 1 to No. 8 Warren street from present location in Park Place.

The Texas Chemical Co., with offices in the Scanlan Bldg., Houston, Texas, has begun the construction at

Manchester, Texas, of a \$500,000 plant which will have when completed a daily output of 100 tons of sulphuric acid. The new plant will be in operation in May.

The Universal Packing Co., Fresno, Cal., has sold its plant to the California Products Co. The factory will be converted for the manufacture of vegetable oil products.

The Southern Agricultural Chemical Co., Atlanta, Ga., has acquired a site for a large plant to be erected near the city.

The National Drug Stores Corporation has increased its capitalization from \$6,700,000 to \$10,500,000.

The Connecticut Metal & Chemical Co., of East Berlin, Conn., contemplates the enlargement of its experimental laboratories.

Cocoon oil valued at \$1,175,000 cleared from the port of New York during January of this year for various foreign countries.

John Campbell & Co., chemicals, etc., are enlarging their plant at Newark, N. J.

The dissolution of the Ajax Aniline Works of Manhattan has been announced.

Work has been started on the new plant of the Southern Agricultural & Chemical Corp. at Egan, Ga. The Pratt Engineering & Machine Co., of Atlanta, Ga., is in charge of operations.

The Mutual Chemical Co. is erecting an addition to its plant in Jersey City, N. J.

Capitalization of F. C. Luthi & Co., exporters and importers, New York, has been increased from \$250,000 to \$500,000.

The Nitrate Agencies Co., New York City, is planning the erection of a factory in Bayonne, N. J.

Advices from Bergen, Norway, to Schieffelin & Co., state that the catch of codfish for the season to March 1 yielded 6,330 barrels of cod liver oil, compared with 3,250 for the previous period.

The Harrison-Walker Refractories Company, in its annual report for last year, shows net profits, after charges and Federal taxes, of \$3,114,477. This was equivalent to \$14.10 a share on the common stock after making provision for the preferred. The previous report was for a fifteen-month period and the earnings then announced were equal to \$26.58 a share.

After dividends last year there was a surplus of \$378,477, which, added to previous surplus, increased the total surplus to \$12,750,509.

Hybal Company, of Buffalo, drugs, chemicals, etc., has been incorporated with a capital of \$50,000. Incorporators, E. Gundlach, A. F. Brautigan, E. G. Fuchs, Buffalo.

Three Point Products Corporation, of Albany, soaps, chemicals, etc., has been incorporated with a capital of \$30,000. Incorporators, L. K. Luff, J. J. Tobin, T. F. Baker, Albany.

A monthly journal devoted to the interests of the drug trade in China has recently made its appearance, notes the "China Press." It is known as the "Chinese Drug-gist."

The National Aniline & Chemical Co. is to make additions to its Buffalo plant to cost about \$5,000,000, according to an unconfirmed report.

The Victor Chemical Company's new plant in the Chicago Heights district of Chicago is now being constructed. The office of the company is at 43 South Dearborn street.

M. H. Avram has resigned the presidency of Avram, Slocum & Avram, industrial engineers, and will head M. H. Avram & Co., Inc., New York, a new corporation with a capital of \$500,000.

The American Clearing Co. is planning the erection of a turpentine plant at Green Cove Springs, Fla., for the extraction of pine oil, turpentine and rosin from light woods and stumps.

The Brooklyn Varnish Mfg. Co. will erect a paint and varnish plant in Los Angeles, Cal. Construction will start at once.

G. Ober & Sons Co., fertilizer manufacturers, Baltimore, Md., has moved its offices to 110 East Lombard street, that city.

According to figures just made public by the Department of Agriculture, the production of oleomargarine in the United States during 1919 equalled 112,746,000 pounds.

The Reed Laboratories, analytical and industrial chemists, have removed from 227-229 Fulton street to 22 East 16th street, New York.

The plant of the Virginia Carolina Chemical Company near Fulton, Virginia, was burned on March 25. The plant, one of the largest in the South, will be re-built.

Recent American Patents

Copies of the Specifications of the Following Patents May Be Obtained from the Commissioner of Patents, Washington, D. C.

- 1,329,853.—MANUFACTURE OF GAS. Walter F. Rittman, Pittsburgh, Pa., assignor to Synthetic Hydrocarbon Co., Pittsburgh, Pa., a corporation of Delaware. Filed February 28, 1916. Serial No. 80,955. Renewed May 27, 1919. Serial No. 300,192. Six claims.
The method herein described which consists in forcing air and steam through a body of incandescent carbonaceous material, utilizing the highly heated gases thus produced to crack hydrocarbon fluids while out of contact therewith, and mingling the hydrocarbon gases and vapors produced by the cracking with the gases formed by the passage of steam through the highly heated carbonaceous material.
- 1,329,898.—BLUE SULFUR DYE AND PROCESS OF MANUFACTURING SAME. Louis Antoine Ferdinand Haas, Paris, France, assignor to Societe Anonyme L'Airliquide, Paris, France. Filed August 5, 1918. Serial No. 248,479. Six claims.
1. A process of manufacture of a blue coloring matter which comprises heating at a reacting temperature with a sulfurizing agent.
- 1,329,950.—PUMP. Henry A. Bloedorn, Reedsville, Wis. Filed March 22, 1919. Serial No. 284,271. Two claims.
In combination, a main pump including a cylinder and rod, a sectional barrel connected with the cylinder, a housing connecting the adjacent terminals of the barrel sections, a supplementary cylinder arranged in concentrically spaced relation to the housing and having a restricted upper terminal, a tubular housing connected with the upper restricted portion of the supplementary cylinder receiving the rod, a piston carried by the rod reciprocally mounted in the supplementary cylinder, a packing ring arranged to prevent the passage of liquid between the piston and supplementary cylinder wall, spaced supporting ribs extending from end to end of the supplementary cylinder and connected with the housing for rigidly maintaining the supplementary cylinder in concentric relation thereto throughout its entire length, and drain pipes connected with the upper restricted portion of the supplementary cylinder above the piston therein and extending through the housing to assist in maintaining the supplementary cylinder in position.
- 1,329,999.—METHOD AND MACHINE FOR MAKING STORAGE BATTERY GRIDS. Lawrence J. Pearson, Willow Grove, and Walter E. Holland, Philadelphia, Pa., a corporation of Pennsylvania. Filed June 19, 1918. Serial No. 240,789. Nine claims.
The combination of a mold made in a plurality of separable parts; and electric devices mounted to uniformly heat the adjacent faces of said parts respectively.
- 1,330,003.—PROCESS FOR PRODUCING CATALYTIC AGENTS FOR REDUCTION OR HYDROGENATION PURPOSES. Augustin Radisson and Paul Berthon, Lyon, France; said Radisson assignor of all his right to Societe de Stearinerie et Savonnerie de Lyon, Lyon, France. Filed May 18, 1917. Serial No. 169,531. Two claims.
An apparatus for preparing catalysts comprising a series of open ended tubes, means for heating said tubes, a casing surrounding said tubes, means for introducing a liquid into said tubes, means for introducing a metallic oxid into said tubes, means for introducing a current of hydrogen into said casing so as to pass through said tubes, means in said casing for distributing the hydrogen gas in the lower part of said casing, and means for distributing the said gas in said tubes.
- 1,330,008.—TREATMENT OF HYDROCARBONS. Walter F. Rittman, Pittsburgh, Pa. Filed February 5, 1917. Serial No. 146,721. Four claims.
The process herein described which consists in subjecting high boiling hydrocarbon oils, in a vaporous state, to conditions of temperature and pressure for a period of time adapted to produce the desired low boiling hydrocarbon, discharging the products of such treatment into a suitable receptacle, reducing the pressure in said receptacle to permit of the vaporizing of the desired low boiling product from the liquid contained therein and condensing the vapors formed at such reduced pressures.
- 1,330,136.—PRODUCTION OF AMMONIUM NITRATE. James Riddick Partington, George Joseph Jones and Thomas Kerfoot Brownson, London, England. Filed December 10, 1918. Serial 266,137. Seven claims.
The process of producing ammonium nitrate which comprises bringing together oxids of nitrogen, oxygen, water and ammonia in such conditions that the proportion of oxygen present in the reaction mixture is in excess of that required on the basis of theory to convert the whole of the oxids of nitrogen into nitrogen dioxide, the proportion of ammonia is insufficient to react with the whole of the oxids of nitrogen and the proportion of water is not in excess of, and is preferably equal to, that which is sufficient to convert the whole of the ammonia into ammonium nitrate by interaction with the oxids of nitrogen for the gluten.
- 1,330,508.—RETARDER FOR CALCIUM SULFATE PRODUCTS. Frank E. Culver, Port Clinton, Ohio. Filed March 17, 1919. Serial No. 283,084. Fifteen claims.
A retarder of the class described including a vegetable gluten as the retarding agent, and a carrier and solvent for the gluten.
- 1,330,288.—SODIUM COMPOUND OF DIOXY-DIAMINO-ARSEN-BENZOL-DIHYDROCHLORID. Umetero Suzuki, Tokio, Japan. Filed June 7, 1916. Serial No. 102,317. Eight claims.
The process of manufacturing sodium compounds of dioxy-diamino-arseno-benzol-hydrochlorid which consists in mixing a solution of sodium alcoholate with a solution of dioxy-diamino-arseno-benzol-dihydrochlorid and then precipitating the resulting sodium compounds by adding ether to said solution.
- 1,330,729.—TORPEDO GUARD. Alla Starr, Paducah, Ky. Filed July 25, 1919. Serial No. 313,207. One claim.
In combination with a torpedo guard and a vessel, a boom pivotally mounted at its inner end on the vessel, the pivot of the inner end of the boom being inclined, and the outer end of the boom being pivotally connected to the guard for universal angular movement.
- 1,330,322.—TORPEDO PLANTING DEVICE. Floyd H. Hutchinson, Hover, Wash. Filed July 24, 1919. Serial No. 313,094. Five claims.
A device of the character described, comprising a handle, a pair of arms pivotally connected to said handle, pockets supported from said arms for receiving the spring fingers of a torpedo and flaring surfaces below said pockets.
- 1,332,419.—PROCESS OF RECOVERING AMMONIA BY MEANS OF SODIUM BISULFATE. Gerhard Nicolaas Vis, Paris, France. Filed October 25, 1918. Serial No. 259,682. Two claims.
The process of recovering ammonia by means of sodium acid sulfate consisting in subjecting sodium acid sulfate to the action of ammonia to form crystalline sodium ammonium sulfate, heating the resulting product with a solution of ammonium sulfate and separating the liquid portion from the residual sodium sulfate and reducing the temperature of said liquid portion to crystallize out ammonium sulfate.
- 1,332,460.—PROCESS FOR THE SYNTHETIC PRODUCTION OF AMMONIA. Georges Claude, Paris, France, assignor to L'Air Liquide (Societe Anonyme Pour l'Etude et l'Exploitation des Procetes Georges Claude), Paris, France. Filed March 14, 1918. Serial No. 222,502. Seven claims.
The process of producing ammonia synthetically from its elements, in the presence of a catalyst, which comprises carrying on the reaction under a pressure within the range of 400 to 2,000 atmospheres, and at a tempera-

ture within the range of 500 degrees C. to 700 degrees C., the heat required for starting the reaction being supplied from without and the temperature of reaction being thereafter maintained by the heat of combination itself with the removal of any excess of heat.

1,332,606.—CARBON REMOVING APPARATUS. William B. Chuck, New York, N. Y. Filed January 6, 1919. Serial No. 269,792. One claim.

A carbon removing device consisting of a number of superposed flexible metallic strands provided at one end with a binding wire forming a handle portion, the opposite ends of said strands being normally free and having hook portions projecting outwardly in various directions from the central line of the bundle formed by said strands.

1,332,349.—PROCESS OF COLORING FLEXIBLE TRANSPARENT MATERIALS. Robert Malcom, Chicago, Ill. Filed July 19, 1916. Serial No. 110,029. Two claims.

The herein described process of coloring non-absorbent transparent materials consisting in coating a celluloid base with a celluloid lacquer containing an anilin dye of a contrasting color to a portion of the sheet or strip of material to be colored.

1,332,860.—COUMARONE RESIN INSULATING MATERIAL. Alfred A. Weld, Caldwell, N. J., assignor to Ellis-Foster Co., a corporation of New Jersey. Filed April 9, 1917. Serial No. 160,745. Nine claims.

A molded electric insulator containing coumarone resin as an essential constituent.

1,332,439.—PROCESS OF MANUFACTURING CYANOGEN COMPOUNDS. Hans Foersterling, Herbert Philipp and Ralph Nelson Sargent, Perth Amboy, N. J., assignors to The Roessler & Hasslacher Chemical Co., New York, N. Y., a corporation of New York. Filed October 29, 1913. Serial No. 798,042. Renewed January 14, 1918. Serial No. 211,899. Eleven claims.

The exothermic process of making cyanogen compounds, consisting in combining the elements of the desired cyanogen compound by admitting a metal susceptible to volatilization and nitrogen gas to charcoal in excess and heated from the outside to about the boiling point of said volatile metal, discontinuing the supply of outside heat upon a reasonable increase in temperature indicating start of reaction, generating heat by the reaction between the elements, promoting the combination of such elements further, admitted, by means of the heat of reaction and absorbing the greater part of the generated cyanogen compound by the excess of charcoal present.

1,332,623.—DISINFECTING OR AIR PURIFYING APPARATUS. Julian G. Goodhue, Chicago, Ill., assignor to the Universal Utilities Co., Chicago, Ill., a corporation of Illinois. Filed April 2, 1914. Serial No. 828,979. Renewed August 1, 1919. Serial No. 314,725. Three claims.

A pair of receptacles positioned with relation to each other to produce an offset portion to one of said receptacles, a valve mounted in one of said receptacles operable to permit fluid to pass from one receptacle to the other when the same are positioned with relation to each other to produce said offset, a tube provided in the offset portion of said receptacle, and an air tube co-operating with the tube in said offset.

1,332,859.—IODINE APPLICATOR. Hartford Sweet, Brookfield, Ill. Filed April 1, 1918. Serial No. 225,995. Renewed June 2, 1919. Serial No. 301,351. Eight claims.

An applicator for antiseptics comprising a sealed cylindrical container having a weakened portion and a hollow wick fitted within the container.

1,332,782.—LIQUID HYDROCARBON BURNER OF THE INJECTOR TYPE. Avando W. H. Vivian, Westminster, London, England. Filed November 8, 1919. Serial No. 336,629. Two claims.

A burner of the character described, comprising a body portion provided with two substantially spherical expansion chambers therein with an expanding passage between the two chambers, and a larger expanding passage exterior to the second expansion chamber, a pipe for conveying air under pressure opening into the first expansion chamber, means for supplying liquid fuel to the passage between said chambers, and suction pipes opening at

their rear ends into said expansion chambers, respectively, and provided at their forward ends with bell mouths projecting forward of said burner and close to the stream of hot gases flowing from said burner, substantially as described.

1,332,730.—PROCESS AND APPARATUS FOR THE OXIDATION AND REDUCTION OF GASEOUS COMPOUNDS. William Koehler, Cleveland, Ohio. Filed October 8, 1918. Serial No. 257,413. Five claims.

The process for the oxidation and reduction of gaseous compounds, which consists in mixing various gases at a common point and raising the temperature of said mixture at said point, substantially as described.

1,330,445.—MOTOR LUBRICATING SYSTEM. Edward Hayes, Lawrence, N. Y. Filed January 22, 1919. Serial No. 272,449. Three claims.

The combination of a motor, having one or more cylinders, a casing including a plate beneath the cylinder or cylinders with dipper recesses therein, means for causing oil to pass from the rear to the forward portion of said casing, and to drop on said plate a cooling casing beneath and secured to said plate, air tubes extending through said casing and a connection from the bottom portion of said cooling casing to the rear portion of said motor casing, said plate having an opening there through into said cooling casing to the rear of said dipper recesses and small openings into said cooling casing adjacent the upper edges of said recesses.

1,330,173.—OIL AND SOAP SOLUTION AND PROCESS OF MAKING SAME. Judson A. DeCew, Montreal, Quebec, Canada. Filed February 25, 1918. Serial No. 219,135. One claim.

A process of making stable emulsions from a blend of oil and soap without the use of alcohol or other chemicals, which consists in compounding the oil with approximately 25 per cent. of its weight of soap by means of heat, discharging the compound while hot into hot water under pressure, and then discharging the mixture into cold water.

1,330,263.—PROCESS FOR PRODUCING REFRACTORY COMPOUNDS. Patent Wilfred M. Handy, Spokane, Wash. Filed June 3, 1918. Serial No. 237,970. One claim.

The process of making a basic refractory material which consists in pulverizing and mixing calcined magnesite, iron compound and silica, and calcining the mixture in a kiln, to cause the oxides of magnesium and iron to unite.

1,330,632.—PROCESS FOR RECOVERING OILS THROUGH THE DESTRUCTIVE DISTILLATION OF WOOD. Patent David L. Hanson, Wilmington, N. C., assignor to Pine Nene Products Co., Jacksonville, N. C. Filed February 7, 1919. Serial No. 275,612. Two claims.

The herein described process of preventing deterioration of the liberated vapors of wood distillation, consisting in subjecting the vapors to a constant pressure stream to remove the vapors from the retort immediately upon generation, said pressure stream consisting of a vacuum pull toward the retort outlet and oxidizing agent introduced remote from such outlet and forcing the vapors toward such outlet, whereby the vacuum pull and pressure agent assist each other in clearing the retort.

1,329,813.—PROCESS OF DRYING SOLIDS. Richard W. G. Stutzke, Chicago, Ill., assignor, by mesne assignments, to the G. A. Buhl Co., Chicago, Ill., a corporation of Illinois. Filed March 28, 1917. Serial No. 157,955. Six claims.

The process of drying solids which consists in continuously introducing such solids into a closed system through which there is set up a circulation of vapors, superheating the said vapors during their circulation and ventilating the system to limit rise of pressure therein.

1,329,845.—PROCESS FOR THE REDUCTION OF HYDROGENATED OIL. William J. Overbeck, Cincinnati, Ohio. Filed October 7, 1918. Serial No. 257,210. Three claims.

The process of producing an impalpable powder from hydrogenated oil which consists in atomizing said oil when in a molten state into an atmosphere at a temperature lower than the temperature of the oil.

CHEMICAL INVESTIGATION EFFICIENCY & CONTROL

CONDUCTED BY

CHARLES B. DAVIS, F.C.S.

ALL classes of work covered by the following subjects will be done for readers of The Chemical Engineer through this department: special research of every description; analysis and reproduction of any commercial product; prevention of waste and utilization of by-products on the most economical basis; valuation of raw materials; food analysis, and disputed points in regard to adulteration, labeling, and the enforcement of pure food laws; bacteriological and enzymatic examinations, including fermentation tests, pure yeast cultures, beverages of all kinds;



development of chemical inventions and industrial processes; examinations and advice on special machinery.

Inquiries of a minor character will be answered on this page, while major matters involving personal investigations, analyses, etc., will, if desired, be treated confidentially through the mails. All questions, materials for analysis, or letters leading to the opening of negotiations for special work will receive prompt attention if addressed to Inquiry Department, The Chemical Engineer, 118 E. 28th St., New York City.

G. E. O'B.—Your mixture of soap, borax, pumice and kaolin cannot be put together and produce a product of the consistency you desire. We are nevertheless devising a working formula for same and will forward it to you by mail.

E. H. C.—The tests, both chemical and physical, can be carried out for you at low cost. We will also include in our report its qualifications as a waterproofing and hardening material for paper and leather.

J. J. S.—As soon as we hear from you again we will proceed with the deodorizing and perfecting of the hair tonic which you are about to market. The sulphurized oil you mention will, we believe, be an excellent addition to the product.

W. G. K.—Ink of the composition you mention in your letter will always tend to clog the float in the well. We are making a research investigation of your formula and will forward results when desired.

W. S.—Tests for determining the use of oil or water in manufacture of cement are now under way, physical tests as to its crumbling and drying out over time are also being made. As soon as we receive the samples requested the working formula will be sent you.

H. B. R.—Chromite may be obtained from the following firms:

Foot Mineral Co., Philadelphia.
E. J. Lavine & Co., Philadelphia.
A. D. Mackey, New York City.
B. F. Drakenfeld & Co., New York City.

J. T.—Soluble blues and blacks for use in writing inks are of both mineral and coal tar origin. They are prepared with various other ingredients according to their use, whether copying or non-copying.

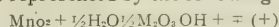
V. T.—Answered by mail only.

D. I. L.—The cement in the spark-plug submitted for test is composed of sodium silicate and alumina oxid and on physical test proved to be soft and porous. A much better cement can be prepared from

kaolin and sodium silicate if heated and maintained at the proper degree.

S. P.—A method for the determination of cellulose in rubber goods can be supplied, but due to its great length will have to be forwarded by mail. The total content of true rubber in the sample sent us will be estimated and results submitted as directed.

T. B.—Allmand's reaction of manganese dioxid as a polarizer is represented by the following equation:



L. T. T.—Dimethylaniline is the most reliable reagent you can use for detecting nitrites in your battery acids. This reagent is sensitive to one part in one million parts of acid.

C. G. O.—On submitting your water sample to chemical analysis, we find it to contain the following ions in milligrams per litre.

Silica (SiO ₂)	16.5
Bicarbonic acid (HCO ₃)	319.7
Iron and Alumina (Fe&AL.)	9.8
Calcium (Ca)	110.9
Potassium (K)	20.1
Sodium (Na)	45.6
Ammonium (NH ₄)	1.6
Magnesium (Mg)	10.5
Cholorine (Cl)	125.4
Manganese (Mn)	1.8
Sulphuric acid (SO ₄)	70.5
	732.4

This water has been artificially carbonated and has no special medicinal qualities.

C. J. S.—We can supply you with complete working formula for preparing Tri-Sodium Phosphate in the crystalline form. The formulas you give in your letter are both incorrect, an acid is first formed and then the salt.

W. C. P. Co.—Thermit is a patented product and can be procured from any chemical house. We are in position, however, to supply working formula for preparing the liquid and dry Lime-Sulphur insecticide.

P. E. H.—We are looking into the matter of hide and skin tanning and you will hear from us at a date in the near future.

Mainly About Chemists

Mr. Neil Kershaw is now with the American Hominy Company, of Indianapolis. He was until recently with the Chemical Division of the Proctor and Gamble Company at Ivorydale, Ill.

Mr. Howard Grafton, formerly chemist at the Mariette plant of the Lavino Furance Company, is now with the Trumbull Steel Company, Warren, Ohio.

Mr. Oscar R. Smith has been appointed chemist and engineer of tests of the B. R. & P. Railroad and is stationed at Du Bois, Pa.

Captain Ross H. Dickson has left the Ordnance Department and is now a chemical engineer in the manufacturing development department of the Standard Oil Company.

Dr. Chase Palmer, formerly chemist of the United States Geological Survey, is now a chemist in the fuel department of the Southern Pacific Company, Bakersfield, Cal.

Mr. Edward G. Harris has left the National Aniline and Chemical Company, Buffalo, N. Y., and entered the employ of the Niagara Sprayer Company, Middleport, N. Y.

Mr. R. L. Comstock has accepted a position with the Warner Chemical Company, Carteret, N. J. He recently resigned from the staff of the Brown Co., Berlin, N. H.

Mr. C. L. McDonough has left the employ of the American Alloy Chemical Co., as chemist, and has associated

himself as chemist for the Warman Steel Casting Co., of Los Angeles, Cal.

Mr. Frantz F. Berg, formerly chief chemist with the Burrough Bros. Manufacturing Co., Baltimore, Md., is now in charge of the pharmaceutical division of E. R. Squibb & Sons, Brooklyn, New York.

Mr. Samuel C. Levy has severed his connections as plant inspector for the Pennsylvania State Highway, and has become research chemist for the Barrett Manufacturing Co., Shadyside, New Jersey.

Mr. H. B. Rodman, formerly captain in the Ordnance Department, U. S. A., stationed in Washington, D. C., has been for a number of months head of the chemical laboratory of the Duratex Co., Newark, New Jersey.

Miss Elizabeth A. Trembath, formerly with the H. J. Heinz Co., Pittsburgh, Pa., and more recently during the war emergency with the Atlas Powder Co. at their Heinz Co., Pittsburgh, Pa., and more recently during & Hasselacher Chemical Co., at their bleaching station, Perth Amboy, New Jersey.

Mr. E. B. Clark has left the laboratories of the Ward Baking Co., and has taken charge of the laboratories of the Omaha Flour Mills Co., Omaha, Nebraska.

Dr. George D. Van Epps, formerly nonferrous and oil chemist for the Continental Motors Corp., Muskegon, Mich., is at present analytical chemist for the Citro Chemical Co., Maywood, N. J.

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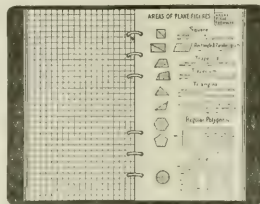
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the data sheets) are available so that you can make your own special data sheets and combine them with the printed ones in the same book. The blank forms can also be used for ordinary notes, diary, expense account, appointments, "graphs," etc.

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CHEMICAL AGE

A CONSOLIDATION of THE CHEMICAL ENGINEER and CHEMICAL AGE

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The Canadian Pulp and Paper Industry

J. Newell Stephenson, M. S.

Editor, "The Pulp and Paper Magazine of Canada"

THE manufacture of pulp and paper is pre-eminently the biggest chemical engineering proposition in Canada. In fact, this industry is in the forefront of the manufactures of the Dominion, and in regard to exports is surpassed only by food-stuffs and provisions. Other manufactured products are hardly in the same class.

Since 1803 paper has been made in Canada, and in that time the growth of the industry has been steady and continuous, while in the last nine years the value of its exports has increased twelve-fold. Latest reports give the annual value of the product

as \$120,000,000 and the value of the exports for the eleven months ending February, 1920, as \$92,968,105. Of this amount, from 75 to 80 per cent. goes to the United States. The entire output of the Canadian paper mills could be sold in that market, but the manufacturers believe in supplying home needs first and some of them have established connections with other concerns under the Union Jack and elsewhere.

With an investment of \$241,344,704, distributed among some 25,000 stockholders, the pulp and paper industry ranks next to electric light and power



Fig. 1—View of Paper and Pulp Mill of the Laurentide Co., Ltd., Grand Mere, Quebec, Showing Dam and Power House

plants in the amount of capital investment. There are 26,000 employees, outside of the necessarily extensive woods operations, and the annual payroll is \$27,000,000. Wages are high and going higher, but the market for pulp and paper is such that very good profits are being paid and the industry is in a very good financial condition. This is indicated by the attention it receives on the stock exchanges and in security circles. Paper mill securities rank very high in Canada and are in constant demand.

There are three principal reasons for this state of affairs—wood, water-power and workmen. Because of her good fortune in these respects, Canada is the cornerstone of the world's publishing industries. It is a rare paper, book or magazine nowadays that is not largely, if not entirely made from wood fibre. Canada's pre-eminence as a pulp and paper producer lies first in the extent and availability of her pulpwood forests, those almost endless stretches of evergreen that cover her mountains and river valleys. No accurate and complete survey of all, or even the most available, forest lands in Canada or the United States has yet been made. Work on this enormous proposition is in progress in Canada and a bill authorizing such a survey will probably be approved by the present Congress. According to data from actual investigation and careful estimates, the Commission of Conservation places the total pulpwood resources of Canada at 1,033,370,000 cords. About half of this, or 530,000,000 cords, is said to be in the eastern provinces. British Columbia is credited with 285,370,000 cords and the prairie provinces with 85,000,000 cords. Besides these quantities of soft woods, mostly spruce, fir and hemlock, there are some 100,000,000 cords of poplar. It may be remarked that timber may be called pulpwood which, under different circumstances, would be made into lumber. The inaccessibility of some regions make surveys difficult and estimates hazardous, and the extent of destruction by fire, wind and disease is often an unknown factor. A beginning was made last year in surveying and mapping by aerial photography from hydroplanes and the experiment was very successful.

The present resources are certainly immense, but the utmost care in cutting must be observed as

well as a policy of reforestation begun immediately. If this is not done the distance that wood will have to be brought to the mill as the cut-out forest recedes will put a transportation item in the production of paper which will make the cost prohibitive. That will mean a migration of the industry to less exploited forest lands, or to countries now beginning to practice reforestation, or the development of other sources of fibrous raw material. This last is not at all likely, as no other material contains so much cellulose in such convenient form.

It should be noted that more than half of Canada's forests are most accessible to the Atlantic seaboard and consequently available to mills best situated to supply paper to the great reading nations of the world. More than one-fourth of the pulp wood is along the Pacific, over whose waters the manufactured product is carried to Australia, the Orient and South America. The coal fields of Alberta and the water powers of Manitoba will one day attract the paper maker to provide for the rapidly developing communities in the great stretches of the fertile prairies.

Great river and lake systems pierce to the very heart of the country like arteries, which they are. The Fraser; Skeena, Saskatchewan, Red, Nelson, St. Lawrence, Ottawa, St. Maurice and Saguenay are only the best known of the big rivers, while, with the exception of Lake Michigan, the largest lakes in the new world are in Canada; the other Great Lakes being on the boundary. Three great



Fig. 3—Sulphur Burners



Fig. 2—Floating Logs to the Carrier

railways cross the continent and the commerce of Montreal is second only to that of New York. Besides the internal facilities, there are several successful lines of ocean steamers flying the Canadian merchant flag.

Another advantage Canada possesses in a marvellous way is the extent of her water powers and especially their proximity to pulpwood supplies and fine mill sites. Thus the wood cut on a watershed is floated to the mill and the water that carries the wood drives the grinder that makes it into pulp

and the machine as well that converts the pulp into paper.

There is a total of 2,418,000 water-wheel horsepower installed in Canada, an average of 274 H. P. per 1,000 of population. With the possible exception of Norway, this is a record. Of this capacity, 473,265 H. P. is used in the pulp and paper industry, more than is used in all other manufacturing industries combined, and nearly three times as much as the nearest rival and—there remains 20,000,000 H. P. to be developed.

Is it any wonder then that the eyes of the nations are on Canada as the world's paper maker? "Surely He hath not dealt so with any nation."

Besides the natural resources referred to, Canada has probably the most reliable and industrious

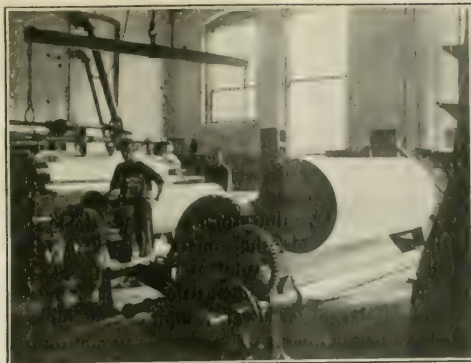


Fig. 5—Paper Rolls



Fig. 4—Sulphite Pulp Press

class of workmen to be found anywhere. Especially in the pulp and paper industry there is a marked degree of mutual understanding and respect between employer and employee, and labor troubles of a serious nature are practically unknown. The wages are good and living conditions in most paper mill towns are comfortable and pleasant.

There are already over 100 mills of all sizes in the Dominion and they stretch from coast to coast. As yet there is no mill operating in the Prairie Provinces, although several charters have been granted to concerns in Manitoba, and the first mill will start work this summer. A glance at the map would show a group of seven mills in British Columbia, where glacier torrents for water supply and power combine with the densest forest in the country and excellent ocean transportation facilities to make the location ideal for the manufacture of pulp and paper. Ground wood, sulphate, and strong, easy bleaching and bleached sulphite pulp, and newsprint and kraft wrapping papers are produced. Steam is produced by burning waste wood, coal from Vancouver Island or oil from California. The finest of limestone is quarried within a few

miles of the mills and sulphur is obtained from Japan, usually, or from Louisiana and Texas. The production of this province, valued at more than \$12,000,000 falls far short of filling the demands of the export market, principally Australia, New Zealand and Japan.

Coming east, we find a kraft mill and a newsprint mill in the western tip of Ontario, then a widely separated string along the Great Lakes, ending in a congested group of twelve mills along the old Welland Canal near Niagara Falls and using power from this source or the fall of the canal. These mills make a great variety, from tissues to wall boards. Other groups of mills will be found along the Ottawa River, in the vicinity of Montreal, along the St. Maurice, and at the head of the Saguenay, while mills alone or in pairs are scattered over the maritime provinces. The main considerations in choosing a site are wood, water power and convenience to markets and supplies of coal and raw material.

The amount of raw material required by this industry is surprising. One large company has between three and four carloads of freight coming into the mill for every ton of newsprint that goes out. If it were necessary, Canada could supply all the basic raw materials required, though it is more convenient and at present more economical to import many of them. Sulphur, for instance, is imported from the United States because it is more convenient than to use pyrites, of which Canada has huge deposits. Rosin, dyes, china clay and some chemicals, such as soda ash and sulphate of aluminum are also largely imported, as are coal and oil, though coal from Nova Scotia, Alberta or British Columbia could be used if necessary, and there are extensive oil fields to be developed. No pulp mill is many miles from a limestone quarry, there is plenty of salt to be converted into bleaching powder, and just recently a very large and valuable deposit of nearly pure sulphate of sodium, the alkali used in making kraft pulp, has been discovered in the west. Large amounts of sodium carbonate are

imported, but the requirements of the pulp and paper industry could easily be produced in Canada if necessary.

The latest available figures for the quantities of materials used in making pulp are for 1917. For that year, the tonnage and values of the principal materials used were: Sulphur, 48,103 tons worth \$1,175,170; sulphate of soda (salt cake), 31,196 tons worth \$436,631; carbonate of soda (soda ash), 5,717 tons worth \$213,122; limestone and lime, 91,335 tons worth \$512,606; and other miscellaneous material valued at \$1,899,336—a total of more than \$7,225,000. These values and quantities would now be considerably larger, as several sulphite and sulphate mills have begun operation recently. In addition to this there is an annual fuel bill of more than \$7,500,000. The paper mills consumed 900,000 tons of pulp in 1917, valued at \$28,617,434, and \$6,000,000 worth of other paper-making materials. Ninety per cent. of the pulp was made in Canada.

A consideration of the kinds of paper most largely made in the Dominion explains the reason for Canada's being so nearly self-supporting with regard to materials. Except for a relatively small production of straw-board, roofing felt, rope manila, and all-rag writing papers, the whole of this industry depends directly on the forest, the degree of dependence depending on whether fibers other than wood are used, and to what extent. The following table gives the kinds of pulp and paper produced in 1917, as reported by the Dominion Bureau of Statistics:

Pulp	
	Tons.
Ground wood	923,731
Soda pulp	4,136
Sulphite pulp	374,894
Sulphate pulp	161,393
Paper	
Kinds of Paper.	
	Tons.
Newsprint (total)	689,847
Book (wood fibre basis)	9,307
Cover	7,141
Plate, map, litho, etc.	10,890
Cardboard, bristol board, etc.	7,845
Coated paper	5,544
Writing and other fine papers.	7,314
Manila (rope, jute, tag, etc.)	1,304
Heavy wrapping (mill paper)	11,869
Straw wrapping	646
Bogus or wood Manila	6,664
Kraft paper	26,646
All other wrapping paper	3,540
Wood pulp board	51,513
Straw board	146
News board	1,578
Binders board	773
Tissue paper	1,069
Toilet paper	1,547
Building, roofing and sheathing.	8,645

The asbestos paper manufactured in 1917 was worth \$14,917.

The Present Situation

The world has never, in peace times, experienced such a shortage of paper as exists at the present time. This is explained by the fact that during the war all efforts were put toward maintaining the

forces at maximum efficiency, so that there was not only a very marked decrease in consumption of paper by the civil population, but there was practically no increase in production. Following the armistice, a revival of business in normal lines took place which was the more astonishing because it was so entirely unexpected. An expression of this revival of particular interest to the paper industry is the enormous amount of advertising in newspapers and magazines. The result is a critical shortage in these lines, although all kinds of mills are operating at capacity and still months behind in their orders. Some mills that had changed from newsprint to other grades because of irksome government restrictions during the war, have gone back to making paper for the press. New mills, also, that were projected before or during the war, are now going forward but the new production will take months and months to become effective, and consequently cannot greatly relieve the present crisis. Building a \$5,000,000 paper mill is no matinee performance.

Most of the new production will be in eastern Canada, because the forests in the Eastern States are so depleted that there is in this district no longer pulpwood to support such an extension of the industry as the growth of the publishing business, especially in the United States, demands. There are some new paper machines planned for in the United States, but they must, for the most part, depend on pulp from Canada, or Scandinavia.

It is significant that, with all the agitation for reforestation in the east, better methods of lumbering and utilization in the south, and more extensive development in the west, there is very little provision being made for a future forest in New England, New York and the Lake States, there is no marked improvement of practice in the yellow pine belt of the south, and no paper or pulp mills are being built in the northwest. Canadians have begun to comprehend what this all means to them in both opportunity and obligation. Canada **must** be prepared to supply a large and rapidly increasing proportion of the world's demands for wood pulp and wood fibre papers. That is why British North America has such attractions for the capitalist, engineer and worker who appreciate the soundness of investment, the fascination of unsolved problems, the fine conditions of employment, and the altogether brightness of outlook of Canada's pulp and paper industry.

AMERICAN GLUE CO. stockholders have approved an increase in the authorized issue of common stock of \$4,500,000, or from \$1,500,000 to \$6,000,000. It is the understanding that the directors' plan, if found feasible and legal under the charter, to declare a stock dividend of 150 per cent., or \$2,250,000, which would make the outstanding common stock \$3,750,000.

The Laundry Chemist and the "Pure Fabric" Law

By H. G. Elledge,

Fellow, Mellon Institute of Industrial Research

The business man is succeeding admirably in dissipating the notion that a chemist is a person who merely "analyses materials." The purchasing agents of the larger business establishments have for a long time resorted to the aid of analysts with the result that materials and supplies are being purchased in increasing quantities on specifications. It is, however, a more recent innovation for the expert salesman to avail himself of the services of the chemist. A movement inaugurated in one line of business rapidly spreads to others; hence it is not at all unusual today to find chemists in the sales organizations of the large industrial corporations. There is presented, therefore, no unique development in the experience of the Laundryowners' National Association, wherein the members found that the chemical engineering department of their Service Bureau, instituted primarily to assist in improving plant operation, should turn out to be of even greater assistance in the selling end of the laundry business.

The chemical engineering department of the Service Bureau of the Laundryowners' National Association functions through an Industrial Fellowship at the Mellon Institute of Industrial Research. The interests of the laundry-owner require constant advice in matters pertaining to water softening, purchasing of materials, the effect of washing reagents on the tensile strength of fabrics of various chemical nature, the most economical use of these reagents, and information on numerous other matters which can best be supplied by one familiar with the "ways of stuff," i. e., a chemist.

The laundry-owner wants to know not only how much real soap is received in a given purchase, but also the detergent power of this soap. He wants to know the available sodium oxide in the washing soda purchased, the yardage of a pound of wrapping twine, and the wrapping area of wrapping paper, and its package-protecting qualities, as indicated by various tests. If kraft is specified, he wants to know of the chemist whether or not the paper received is kraft.

This information is necessary for the economical production of laundry service. The production of this service is no more essential to the prosperity of the laundry business than is the sale of this service, which differs from most selling propositions in that the service must be sold before it is produced. The selling of service necessarily requires satisfied customers. To keep satisfied customers for a laundry it is necessary, in addition to proper renovation and delivery of the linen, to make fair adjustment of the claims for the occasional damage occurring to fabrics, which, on account of human frailty both within and without the laundry, will occur from time to time.

The adjustments can not be based upon that false principle held by too many business men that "the customer is always right." In many cases this would be the easy and expedient method for the

individual laundry to pursue. Such a procedure, however, is not conducive to the healthy growth of the industry in general, because the practice fosters prejudices against laundry service, which, on account of previous sins, still prevail, even though the service is improved. Fair adjustment must be based on the determination of the true responsibility in each case. The three agents responsible for the conservation of textiles are the manufacturer, including the distributors all along the line to the retailer, the user and the launderer. To secure evidence that will establish this responsibility in a given instance, the Laundryowners' National Association offers to its membership the services of expert chemists.

As examples of typical claims made against the laundry, the following incidents are cited. A linen supply company that furnishes clean towels to offices purchased a lot of seven hundred hand towels. Since new towels are not sufficiently absorbent for use until after they are washed, this lot was sent to a laundry. All of them failed in the first laundering. Exhibits were submitted to the L. N. A. laboratory and the cloth was found to be composed of cotton warp and an over-cooked hemp filling. When the fabric was dry, the strength along the filling direction was about equal to the strength along the warp direction; but when it was wet the strength along the filling was comparable to that of paper. The fact was, the cooked hemp of which the filling threads were composed constituted a good grade of paper stock. If the hemp had not been cooked it would have had sufficient strength, and would have been extremely harsh and with no power to absorb moisture, an essential property of a good piece of toweling. The fabric had the appearance but lacked the other essential qualities of good crash.

This represents an extreme case of fraud; like the knave's paper razors, the fabric was made to sell. Obviously, the responsibility here was not that of the user or the launderer. While instances of this extreme character are comparatively rare, it is to gain protection for the user and launderer against situations of similar nature, qualitatively if not quantitatively, that the Laundryowners' National Association has entered the fight for "pure fabric" legislation.

The patron of a laundry in New England purchased some white shirts. On the first trip to the laundry, holes appeared in each shirt at the armpit. The shirts were sent to the laboratory with a new, unsoiled shirt of the same lot. No evidence of any defect could be found in the cloth of the new shirt or the cloth of the damaged ones, except in the immediate area surrounding the holes. The cotton bordering the holes showed by the copper reduction test evidence of oxycellulose or hydrocellulose. That is, the tendering had been effected by an acid or an oxidizing material. An investigation, previously carried out, had resulted in the compilation

of a list of household materials, cosmetics, nostrums and toilet articles which will cause the tendering of cotton and linen fabrics. The class of products suggested by the chemical test and the location of the holes, is known as deodorants or anti-sweat preparations.

These materials, the purpose of which is to interrupt the functioning of the sweat glands and in some cases to oxidize the secretion, usually contain zinc or aluminum chloride, which, in the presence of moisture, forms, by hydrolysis, hydrochloric acid. The owner of the shirts, when confronted with this information, admitted that he had used such a preparation and that, therefore, in this instance the responsibility was that of the user of the fabric. Specific examples of similar destruction of fabrics by the user might be extended much beyond the scope of this article.

The laundry operation is like all factory processes in that the human factor obtains. In addition to this unavoidable condition some establishments are blessed with poorer management than others. The stock in trade in the laundry industry is service, service to steamship companies, Pullman companies, hospitals, hotels (although most of the larger hospitals and hotels operate their own laundry plants), and to the household. The laundry-owner recognizes that the greater number of times he can launder a fabric, the more profit accrues to him. It is, therefore, to his interest to conserve textiles in laundering them. It is also recognized that well managed plants suffer from the ill-will created by the poorly managed ones. Consequently, the broader-minded men of the industry, who exercise the most influence in their trade association affairs, are concerned with the improvement of conditions in the poorest plants. To correct a mistake and prevent its recurrence requires the location of the cause. With such features is the chemical engineering department of the Laundryowners' Service Bureau occupied. Incidentally in the investigation of such matters as are here outlined, the chemist has afforded valuable data for constructive advertising, another contribution to the selling phase of the business.

"Pure Fabrics" Legislation

The legislation regarding textiles sought by the laundry-owners could more properly be called a law requiring the correct labelling of fabrics. While there are many features in which the analogy to the Pure Food and Drugs Act is quite distinct, there are others which bear no similarity. There is no intention to restrict the market or to hamper the honest producer or dealer. The object of the legislation sought is to promote better care in the weaving and dyeing of fabrics, and to conserve the interests of the honest producer and dealer as well as those of the ultimate consumer and the launderer.

It is appreciated that there are many grades of raw materials that must be used in the total output of our textile mills, that automatic machinery and human hands are not infallible, and that economic necessity demands that all products of the mills at all suitable for use must be, somehow, marketed. There is the added appreciation that some means must be decided upon for curtailing deception, whether this deception be perpetrated by the producer or by unscrupulous jobbers into whose hands defective or inferior textiles might fall. In other words, goods classified as defec-

tive or seconds in the reputable mills should be so indelibly branded that they would be less easily passed as good cloth, should they find their way into the hands of dishonest distributors.

The whims of fashion constitute a great menace to real economy in the use of textiles, especially those used in garments and table fabrics. A demand for soft collars which look like silk, but which may be sold at a comparatively low price, encourages the production of a cloth of cotton warp and silk filling so woven that the cotton is mostly concealed. In an exhibit illustrating this recently examined, the coarse warp yarn constituted 90 per cent. of the weight of the cloth, leaving only 10 per cent. of the weight for the silk filling. The manager of a large garment manufacturing company of highest standing explained that it was necessary to produce such an article to meet competition. Perhaps, if from the label, the purchaser knew the weakness of the fabric and that it would not survive the most careful hand-washing, the demand for articles made of such cloth would be diminished.

Another temptation toward deception is to be found in the manufacturing of table linen. A damask type table cloth may be made of short staple linen yarn or even cotton yarn and so finished that the purchaser will not detect the inferior quality until after the sizing has been removed. "Tow" yarn, properly spun and woven into any plain weave pattern, will make a serviceable cloth for many purposes, but short staple fibres, loosely spun, should never be used in jacquard designs.

Prints that have been tendered by the excessive or improper use of stripping salts; shirting in which the dyed stripe of the warp has been tendered by faults in dyeing, or by the ageing effect of sulfur dyes; defects in weaving concealed by sizing; blankets of cotton warp and wool filling so woven and carded as to give the appearance of wool, but with the wool filling so weakened by the carding as to render the blanket almost useless; these are more of the faults in new textiles that have been examined in the laboratory of the Laundryowners' National Association at the Mellon Institute. These and other considerations have led to the proposal that a federal law be enacted to compel the correct labelling of fabrics.

The details of this law are not the subject of this article. Suffice it to say that the enactment should be comprehensive enough to make it effective without making it unnecessarily burdensome to the honest producer. The kind of fibers and the tensile strength of each set of members, the warp and filling, should at least be specified. As the functioning of the Bureau of Chemistry, more than that of the courts, was required to interpret and make effective the operation of the Pure Food and Drugs Act, so, very likely, there will be required an organization of chemists and textile experts, perhaps a section of the Bureau of Standards, to make possible the equitable and satisfactory enforcement of a "Pure Fabric" Law.

Basic Electrons

Charles B. Davis, F.C.S., is preparing a series of articles on the isolation of basic electrons. It is expected that the first article, dealing with the production of bismuth from these electrons, will be published in an early issue.

American Artificial Silk Manufacture

The entrance of the du Pont organization into the field of artificial silk manufacture, represented by the alliance of the du Pont Co. with the Comp-toir des Textiles Artificiels of Paris as noted in the last issue of Chemical Age, directs attention to the remarkable development of this branch of the plastics industry.

An additional newcomer in the domestic industry appears in the Tubize Co., a Belgian corporation, which has acquired manufacturing facilities at the former munitions town of Hopewell, Va., and will establish at this place a plant for the production of artificial silk.

This accession to American production will be known as the Tubize Artificial Silk Co. of America and is an offshoot of the parent plant located at Tubize Belgium, 15 miles from Brussels, where over 5,000 hands are now employed. Of these about four thousand are women, who attend to the spinning, while the rest are men who are engaged in the chemical and other branches of the industry.

While not a substitute for the silk fibre in the sense that it displaces the natural product, the artificial fibre of cellulose base possesses properties that make it an admirable supplement. The increasing demands and resulting high prices of natural silk fibre and fabrics naturally encourage the growth of the artificial filament industry.

With the experience of the du Ponts in handling nitrated cellulose products their expansion into this field is a natural step from which, if one may judge from their commercial enterprise and technical capacity in other departments of the chemical industry, great things may be expected.

The artificial silk industry had its inception in the experiments of Count de Chardonnet who in 1884 produced the first successful fibre, and in 1889, the industry, based on patents granted to him, exhibited its product at the Paris Exposition.

Briefly, there are three general varieties of artificial silk based upon the method employed to reduce the cellulose to solution and of precipitating the filament formed by forcing the gelatinous mass through orifices: (1) cellulose nitrate silk made by the Chardonnet process and modifications thereof; (2) cuproammonium silk, so called from the cellulose solvent used; and (3) viscose silk.

While raw or waste cotton is the customary raw material of the Chardonnet and cuproammonium processes, viscose silk is based upon wood cellulose, chiefly of spruce origin. As a matter of fact cellulose of suitable purification and of whatever origin may be an acceptable raw material as the art of artificial silk manufacture is practiced today.

Viscose silk is based upon the cellulose thiocarbonate-solution discovered by Cross, Bevan and Beadle in England in 1892 and which is the result of treating purified cellulose, suitable reduced by the action of caustic soda, with carbon disulphide. This unique product, called "viscose" on account of its exceptional viscosity, not only is distinctively English in its origin, but in the commercial development of the industry based upon it.

It was about eight years after the discovery of the viscose solution before attempts were finally made to apply it in a commercial way to the manufacture of threads and filaments. In 1900, experimental plants were established in England, France

and Germany to perfect and carry out the process along commercial lines. England was the first country to succeed in this in the largest way, and which was due to the efforts of Samuel Courtauld & Co., now Courtauld's, Ltd., which had taken over the process for that country.

In the United States, a large amount of experimental work was done, at first by The General Artificial Silk Company, but whose efforts were not successful in producing a yarn required by this market.

This company was taken over by The Genasco Silk Works who continued the work started by the former company and produced a marketable yarn, but only in small quantities.

It was not until 1910 and 1911 that a plant was erected in this country solely for the production of this material, although over \$1,500,000 had been spent up to that time in the United States in experimental work in order to make this possible.

Courtauld's, Ltd., with head manufacturing plant at Coventry, England, is inseparably connected with the successful development of the artificial silk industry as we know it today in England and America. The Viscose Co., with manufacturing plants at Marcus Hook, Pa., and Roanoke, Va., employing respectively about 3,500 and 1,500 hands under industrially ideal conditions of employment, are the American branches of the English house. Here under the technical direction of Dr. C. A. Ernst and the sales management of Samuel A. Salvage, the experiments of Cross, Bevan and Beadle, have found successful economic fruition under such present conditions of demand as to make the business problems chiefly those of allocation of the material produced.

The American industry as stated had its origin in the formation of the General Artificial Silk Co. with plant at Landsdowne, Pa., which was taken over by The Viscose Co. on the establishment by Courtauld's, Ltd., of its American branch in 1910-11.

The preeminence of the Viscose Co. in the American industry and the extent of its business, are indicated in the following table showing the importation of artificial silk, the total consumption in this country and the contribution thereto of the Viscose Co.:

	Total Imports, lbs.	Production of Viscose Co., lbs.	Consump- tion, lbs.
1912	1,631,807	1,117,285	2,749,092
1913	2,395,599	1,565,583	3,961,182
1914	2,590,490	2,443,954	5,034,444
1915	3,044,316	4,107,385	7,151,701
1916	973,082	5,741,338	6,714,420
1917	543,446	6,696,861	7,240,307
1918	120,540	5,827,627	5,958,167
1919	1,072,040	8,173,824	9,245,864

It is claimed that viscose silk possesses many advantages over the artificial silks made by the nitro or copper processes; that its coloring power and lustre are greater owing to the curious shape of the cross section of the filaments; that the mild nature of the chemical reactions to which it has been subjected causes the cellulose hydrate of which it is composed to be much less disintegrated.

For instance, many or most samples of nitro silk, such as that made by the Chardonnet process dissolve to the extent of about 80 per cent in a solution

of 8 per cent caustic soda, while a good sample of viscose silk only dissolves to the extent of 10-20 per cent in the same solvent. This results in the thread being much more resistant to the finishing processes to which piece goods are subjected, so that it can be woven together with unbleached cotton and then bleached, dyed and finished in the piece. The resistance to water is also increased with the result that when wetted the strength of the best viscose is greater than that of any other form of artificial silk.

The great regularity in size and affinity for dye-stuffs is obtained by employing extreme care in the scientific control of the various processes such as the preparation and composition of the alkali cellulose and viscose at all stages, the composition of the spinning bath and the regularity of the minute holes used for spinning. Any variation in these conditions results in an unevenness of the thread hardly appreciable in the skein form, but giving extraordinary effects in the form of stripes and bars when it is woven into cloth. The operations involved in the manufacture are of great delicacy and the unremitting care required is indicated by the fact that the complete conversion from sheets of wood pulp to skeins of finished yarn requires a period of about ten days.

While hosiery is the principal knit goods line in which artificial silk has been used it is coming into more general use in other lines. In fancy knit goods for example, shawls, caps, sweaters, etc., are being made, wholly or in part of artificial silk, and the demand for such articles is steadily increasing.

One of the recent developments in the knit goods industry is the making of underwear from artificial silk. Here, as in the case of hosiery, the fibre is plated on cotton. Garments thus made have a handsome appearance and a large sale for them is predicted.

Artificial silk is also used in the manufacture of neckties, both knitted and woven, braids and other trimmings, embroideries, laces, imitation furs, tapestries, copies of oriental silk rugs, etc.

Although the cost of artificial silk is only about half that of real silk, the former has not come into direct competition with the latter. Rather has it worked out a field for itself, and, due to its greater lustre, it is seldom used as an adulterant of real silk.

Wood Distillation Industry of Canada

The production from wood-distillation plants in Canada in 1918, the latest year for which statistics are to be had, was valued at \$7,634,122, this total including the item of \$398,905 for repairs to machinery and plant made by employees.

While the industry was stimulated by war needs, a considerable export business was done prior to 1914 in a number of wood-distillation products. Considerable quantities of acetone and acetic acid were produced by the wood-distillation method for use as solvents in the manufacture of cordite. Wood alcohol was exported largely to Great Britain and Australasia before the war, in addition to the Canadian consumption, where it was used for the manufacture of soaps, perfumes, and methylated spirits.

Capital, Wages, and Miscellaneous Expenses

There are 13 plants, of which 8 are located in

Ontario and 5 in Quebec, with one refinery in each province. The amount of capital invested was \$3,612,573, of which Ontario's portion was \$2,321,881 and Quebec's \$1,290,692.

The amount paid in salaries and wages to 675 male and 2 female employees was \$731,435. The number of male employees within specified groups of classified weekly wages as on December 15, 1918, was as follows: Under \$10 a week, 1; from \$10 to under \$15 a week, 2; from \$15 to under \$20 a week, 246; from \$20 to under \$25 a week, 301; over \$25 a week, 111.

The charges for fuel of all sorts used during the year amounted to \$839,966, of which \$67,954 worth was of Canadian origin and \$772,012 of foreign origin. Miscellaneous expenses totaled \$365,789, and included such items as rent, power, insurance, taxes, traveling expenses, and ordinary repairs to buildings and plant.

Cost of Materials—Value of Products

The quantity and cost of all materials delivered at the works during the year were:

Materials used	Quantity	Cost value at works
Hardwoods, cords.....	128,097	\$1,321,893
Lime, bushels	140,420	57,423
Crude wood alcohol for further manufacturing, gallons	1,081,837	1,071,227
Acetate of lime for further manufacturing, pounds	20,868,427	829,675
Caustic soda, pounds.....	186,900	7,709
Sulphuric acid, pounds.....	1,050,240	11,527
Soda ash, pounds	234,191	13,637
Other miscellaneous materials, pounds	445,986	6,640
Total		\$3,319,731

The quantity and value of the various products of the industry at the point of production are given in the following table:

Products.	Quantity.	Selling value at works.
Wood alcohol:		
Crude (sold as such), gallons	875,024	\$981,535
Refined (sold as such), gallons	1,070,928	1,531,356
Acetate of lime, pounds.....	25,998,139	1,017,465
Acetic acid, pounds.....	1,772,223	170,173
Acetate of soda, pounds.....	295,572	51,389
Acetone, pounds	3,458,810	909,570
Formaldehyde, pounds	1,154,902	159,263
Ketone oils, pounds.....	792,854	211,440
Acetic anhydride, pounds.....	44,981	60,515
Methyl acetate, pounds.....	132,121	29,350
Charcoal, bushels	6,472,925	1,575,701
All miscellaneous products.....		537,460
Repairs to machinery and plant by employees.....		398,905
Total		\$7,634,122

Dehydration of grapes is a new industry that is coming to the fore since the reaction of the prohibition laws against wine grapes. The California State Corporation Department has granted to the Dinuba Dehydrator Company of Fresno permission to sell shares of its stock for the erection of a plant having a capacity of 25 tons per charge. The company is organized to construct and operate a two unit dehydrator of the ceramic oven type. The authorized capital of the company is \$25,000 and the permit gives authority for the sale of the entire capital.

Potash Recovery in New Jersey

The Plant and Process of the Eastern Potash Corporation

By R. Norris Shreve

The Eastern Potash Corporation has under construction on the Raritan River near New Brunswick, N. J., a very large plant to produce high grade potash compounds from New Jersey greensands. This plant will turn out over yearly somewhat over 20,000 tons of caustic potash or the equivalent in other potash salts.

The greensand deposits, in the richer beds, are made up almost entirely of the mineral, glauconite, which has hitherto been considered as a hydrous silicate of iron, potash and alumina. The greensand contains $7\frac{1}{2}\%$ potassium oxide. Many attempts in the past have been made to get potash from silicates, and in fact a number of large plants have been built for this purpose. Practically all of these plants have worked on massive silicate rocks, such as feldspar, leucite, etc., in which case the rock had to be subjected to an expensive crushing and grinding process before any attempt was made to unlock the potash. Furthermore, in most cases these rocks were located in inaccessible regions where they were not only difficult of access but where the resultant potash compounds, more or less contaminated with soda salts, had to bear an expensive freight haul to reach the markets. The greensand deposits of New Jersey, used by the Eastern Potash Corporation as its raw material, can be mined easily by steam shovel and will be subjected to a freight haul of only a few miles to reach the company's plant. Furthermore, the greensand is

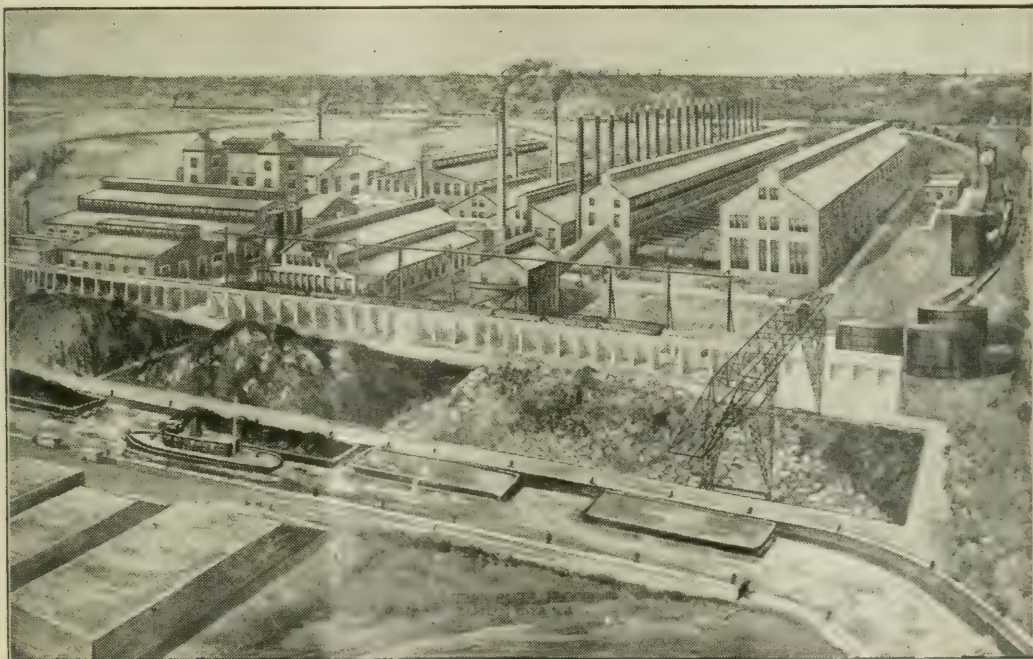
comparatively easy to decompose as compared with feldspar and the like.

The process of decomposition which will be employed is that invented and patented by H. W. Charlton to cover the decomposition of feldspar and modified by T. C. Meadows and H. W. Charlton as applied to greensand. Under these patents greensand, lime and water are digested together at a fairly high temperature and pressure. Subjected to these conditions the potash in the greensand is converted into soluble caustic potash.

Initial Investigation

Some years ago the Eastern Potash Corporation established a small manufacturing plant at Jones Point, N. Y., for the purpose of solving, on the actual manufacturing scale, the problems connected with the extraction of potash from greensand. This plant was capable of treating ten tons of greensand a day, and large scale equipment for the handling of the problem in all its phases were installed and tried out at this plant. These experiments have already involved an expenditure of about \$300,000, but this has been money well spent, as without such a large scale experimental plant, it would have been difficult to properly design and build the large plant at Raritan River now under construction.

The Raritan River plant will treat every day 1,000 tons of greensand for the recovery of its potash. This greensand will come from the very



Plant of Eastern Potash Corporation at New Brunswick, N. J., in Process of Construction

rich beds which are located only a few miles from the plant. The United States Geological Survey in its report on the "Greensand Deposits of the Eastern United States," states that "the greensands of the Eastern States underlie the surface of hundreds, if not thousands, of square miles within the reach of the steam shovel. A square mile of greensand one foot thick will yield 78,000 tons of potash. A twenty-foot bed that covers a square mile should yield 1,500,000 tons of potash."

Procedure of Treatment

The greensand will be treated with lime and water and for this purpose about 900 tons of quicklime will be needed every day. This quicklime will be made at the Raritan River plant out of limestone which will be supplied from the company's very extensive quarries located at McAfee, Sussex County, N. J. The stone occurring here is a very high grade of metamorphic limestone running 93-96% calcium carbonate. Quarrying and crushing machinery is now being installed to supply 1,700 tons per day of the crushed limestone, which will be transported by a haul of approximately fifty miles to the company's Raritan plant.

For the burning of the limestone there is now being built the largest lime plant in the world. This lime plant will consist of ten Vulcan Rotary Kilns, 8 x 125 feet.

The limestone, crushed at the quarry to a uniform one inch size, will be discharged from the railroad cars into an unloading hopper which will feed directly to a conveyor belt for carrying the material to small storage bins above the rotary kilns, from which it will be automatically fed into these kilns. Excess shipments will be dumped and removed to main storage space of 500 feet long by 147 feet wide by a large gantry crane, and piled for use in time of interrupted shipments.

The hot lime discharged from the kilns will be cooled in rotary coolers and slaked at the end of the cooler with an excess of water, thus giving a lime slurry which will be transported by pumps.

The lime kilns will be heated by oil and the waste gases will be collected and used under waste heat boilers, thereby producing 1,500 B. h. p., which will be equivalent to saving 50 tons of coal daily.

The greensand will reach the plant by barge in a fine granular sandy condition, and be unloaded by the gantry crane. As in the case of limestone, there is ample storage space to accommodate a supply and the crane is of ample capacity to supply the normal demand of the grinding mills and take care of the storage. It will be conveyed to the greensand grinding building, where, mixed with water, the greensand will be ground so that 90% of it will pass a 200-mesh screen. This grinding will take place in tube mills. From the mills, pumps will elevate the ground greensand pulp to storage and measuring tanks, and thence to mixing tanks where the greensand, lime and water will be mixed in the proper proportions.

The resulting slurry will have a composition of 1 part of greensand, 1.2 parts of calcium hydroxide, and 4.8 parts of water.

The day's charge will consist of the following quantities: Greensand, 1,000 tons; quicklime, 900 tons; water, 5,100 tons.

The charge of the proper proportion having been prepared, it is then sent through the digesters where the conversion takes place. Here the slurry will be

heated to 470° F., which is the temperature equivalent to 500 lbs. saturated steam. To keep the water in the liquid phase, the slurry will be put under sufficient pressure to prevent the formation of steam. The slurry will be kept in the digesters at this temperature somewhat more than an hour's time, which will effect a conversion into the soluble form of about three-quarters of the total potash contained in the greensand.

The specific type of digesters that will be used are those developed by the company's engineers after long experimentation. These now are under construction. They consist of a heating-up element comprising a coil within a shell. The slurry is pumped continuously through the coil which is surrounded by steam of 500 lbs. pressure. After thus having been brought up to the proper temperature the slurry is conducted into cylinders where the reaction progresses to the desired stage. The hot slurry will enter one end of these cylinders continuously and will leave at the other end. Several of these cylinders are to be connected in series and their size and dimensions are so chosen as to hold the hot slurry for the length of time necessary to effect the conversion.

After leaving the digesters, the hot converted slurry will have its heat removed in slurry boilers which are simply special boilers in which the hot liquid is used as the source of the heat and thus generates steam for the plant. The excess pressure of the slurry is removed by friction in small pipes. The slurry now cooled below the boiling point of water is filtered in standard filters and the liquid caustic potash thus obtained is sent to the evaporator building for concentration.

In the evaporator building is located a large Manistee quadruple effect evaporator, which will be employed to concentrate the caustic potash to 45° Be. This evaporator plant, now under construction, will have a guaranteed capacity of 5,000 tons of water evaporated in each 24 hours, utilizing exhaust steam exclusively.

The 45° Be. caustic potash solution will be concentrated further to the ordinary 90% solid caustic in the regular type of cast iron caustic pots which will be heated by oil.

A number of potash compounds other than caustic potash will be made, for example, potassium chloride, potassium chlorate, potassium nitrate, potassium sulfate, potassium carbonate, potassium bicarbonate.

The purity of all of these compounds of potash, as produced by the above described process, will be very high, indeed. The greensand in the first place contains practically only traces of sodium compounds, being totally unlike most other potash minerals in this respect. Furthermore, the greensand carries merely traces of chlorides and of sulfates, so that the caustic potash obtained will have only very small amounts of these contaminating impurities, being in this respect a very exceptional product.

Utilization of Residium

Turning back now to the residue that was separated by filtration from the liquid caustic potash, the company plans to utilize this in a number of different ways.

For example, the excess lime and the silicates formed in the reaction are capable of reacting with

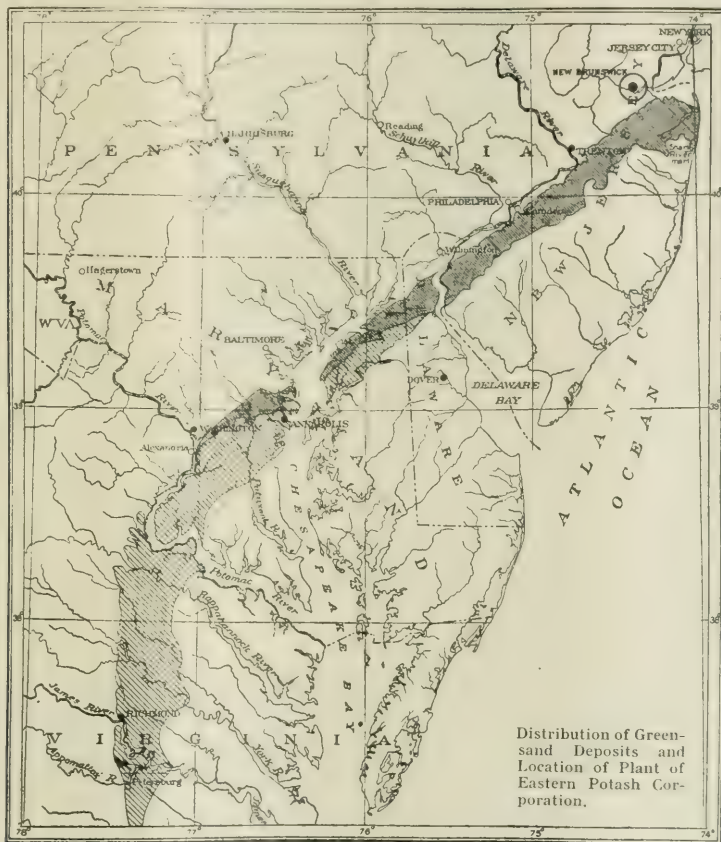
the silica of sand to form a variety of ceramic products.

The company is now preparing designs for a plant to make 500,000 brick per day out of this residue. This is to be carried out by mixing the residue with sand, and pressing this material into bricks. These bricks are then placed in hardening cylinders where they are to be subjected to 150 lbs. steam for some hours to effect the reaction between the cementitious materials of the residue and the sand.

These bricks have been produced now for several years at the company's experimental plant at Jones

In order to handle the very large tonnage of raw materials economically, the company is digging a canal to parallel its storage yard. This canal, as well as the railroad trestle paralleling the other side of the storage yard, are shown in the illustrations. A large gantry crane for unloading and transporting raw materials is now being erected.

All and all, the Eastern Potash Corporation's plant at Raritan River will be the most important factor in the United States in the production of high grade potash compounds. Its products will not be hampered by the heavy freight rates to which the plants located in the western part of the



Point, N. Y., and have successfully stood exhaustive tests. The brick now being used in building the Raritan plant have been made at the company's experimental works.

Other ceramic products, especially stucco and various molded forms, have been made out of this residue, and it is the company's intention to market this residue for the manifold demands for such products in the New York and Philadelphia markets.

The residue, carrying as it does about 50 per cent. of lime together with considerable silica in a very finely divided form, will also find a large outlet in the fertilizer industry where lime and silica are needed.

United States are necessarily subject, upon reaching

the main potash markets of the United States. The potash compounds produced by the Eastern Potash Corporation will be of unusual purity and the company is planning to meet the exacting requirements of the chemical trade as well as, of course, the demand for fertilizer purposes.

J. P. Devine Co. has moved its New York office from the 42d Street Building to 50 East 42d street, where Mr. W. H. Buchhagen will be glad to discuss all technical problems relating to the Devine line of chemical equipment. The experimental laboratory at Buffalo has been enlarged and equipped to handle experimental problems relating to chemical manufacture.

Dr. Frederick D. Cottrell

Director Bureau of Mines

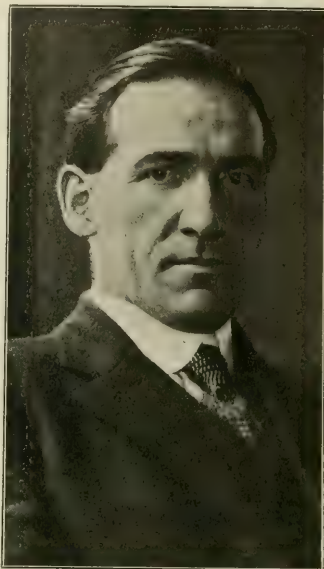
The resignation of Dr. Van H. Manning, Director of the Bureau of Mines, effective June 1st, when he became Director of Research of the American Petroleum Institute, is a forceful example of the active emigration of government scientific workers to private industry, where, while their work may be less direct in the public interest, their compensation is a more direct reflection of appreciation of their value.

Dr. Manning's successor is the present assistant director, Dr. Frederick G. Cottrell, chemist, metallurgist and inventor. Dr. Cottrell is a native of Oakland, Cal., where he was born January 10, 1877. He is a '96 graduate of the University of California. After three years' service as a teacher of chemistry in the Oakland High School he studied at the universities of Berlin and Leipzig, receiving his doctor's degree from the latter institution in 1902.

On his return to this country in 1902, he was appointed instructor in physical chemistry at the University of California, and in 1906 was appointed assistant professor, holding this position until 1911. While at the university Dr. Cottrell's chief contributions to science were researches relating to the electrical precipitation fume and fine particles suspended in the gases of smelter, blast furnace and cement works flues. He finally evolved what is known as the Cottrell process for this purpose.

This invention was first utilized at the Selby smelter in California for removing fumes from the waste gases of a sulphuric acid plant at the smelter, thereby abating a nuisance that threatened to necessitate shutting down the works. Subsequently this electrical precipitation process was installed at other smelters to remove fume and solid particles contained in the escaping gases, and it was also successfully used at cement plants, notably near Riverside, Calif., to prevent the dust from the calcining kilns from damaging nearby orange groves and vegetation. Today the Cottrell process of fume and dust removal is in world-wide use, and is recovering materials heretofore wasted to the value of many thousands of dollars. One of the latest installations is at a large smelting plant in Japan; while the largest installation is at the Anaconda smelter, Anaconda, Mont. Dr. Cottrell, in a desire to encourage scientific research, turned over his extensive patent rights to a non-dividend paying corporation, known as the Research Corporation, a body formed for that purpose. A fundamental requirement in the incorporation is that all net profits shall be devoted to the interests of scientific research.

In 1911, when Dr. J. A. Holmes, the first director of the Bureau of Mines, was serving as a member of commissions appointed by the Government to



Dr. Frederick G. Cottrell

study alleged damages from smoke and fumes from the Selby and the Anaconda smelters, and the Bureau of Mines was investigating at length the smelter-smoke problem, Dr. Cottrell, because of his scientific attainments and his special knowledge of metallurgical problems, was appointed chief physical chemist in the bureau. In 1914 he was appointed chief chemist; in 1916, chief metallurgist, and in 1919, assistant director.

Aside from his work on smelter smoke, Dr. Cottrell has been deeply interested in and intimately connected with work on the separation and purification of gases by liquification and fractional distillation. During the world war and subsequently thereto the development of the Norton or Bureau of Mines process for the recovery of helium from natural gas has been his special care, and it was chiefly

through his efforts that a plant for recovering helium on a large scale for military aeronautics has been erected near Petrolia, Texas.

Dr. Cottrell was awarded the Perkin medal by the New York Section of the Society of Chemical Industry in 1919 in recognition of his work on electrical precipitation.

First Year Book of the New Jersey Chemical Society

The first year book of the New Jersey Chemical Society appears as a neatly bound 6x9 volume of 108 pages embracing a presentation of the society's activities since its organization in October, 1918, a survey of chemical educational work in New Jersey, a statement of the facilities afforded chemists by the free public library of Newark under the direction of Dana Cotton, together with a valuable index, classified by products, of the chemical manufacturers and supply houses of New Jersey. Local manufacturers and consumers of chemicals have shown their appreciation of the functions of the society by a creditable volume of business announcements.

The exceedingly practical character of this publication reflects the objects of the society which are to give the trained chemical workers in a great manufacturing state an economic solidarity in line with other organizations concerned with manufacture, transportation, trade and finance. Those who organized the society, the officers and members now over 300, and the guests who contributed to the thought of the periodical meetings well may view with satisfaction this useful initial narrative of an interesting experiment in American chemical history.

Celluloid Without Camphor

Golden Anniversary of the Celluloid Co., and the Silver Anniversary of the Association of William G. Lindsay, Chief Chemist

John Wesley Hyatt, an Albany, N. Y., printer with an inquiring and ingenious mind sought about 1870 for a substitute for ivory for the billiard ball. He based his experiments upon those of Alexander Parkes, an English chemist, who studied the behavior of nitrated cotton cellulose with solvents. Hyatt, mixed pyroxylin and camphor and obtained a product admitting of great flexibility of treatment. The first moulded article was a dental plate. Isaac Smith Hyatt, his brother, left journalism to assist his brother, and to whose vocabulary we are indebted for the term "celluloid" which the brothers copyrighted as the name of their product.

On January 30, 1871, The Celluloid Manufacturing Company was organized at Albany, New York, for the manufacture of this new material. In 1872 the business was transferred from Albany to Newark, N. J., which city has remained the home of The Celluloid Company ever since. In 1875, this first small plant was replaced by a new and larger factory, followed in succeeding years with many additions, until today the company's plant covers twelve blocks in the city of Newark, with twenty-nine acres of floor space.

On November 25, 1890, the present The Celluloid Company was formed by the merger of The Celluloid Manufacturing Company with the several subsidiary companies that had been organized to fabricate and market the material made by the Manufacturing Company, thereby centralizing the manufacture and fabrication of celluloid.

The capital stock of The Celluloid Company is \$6,000,000. Marshall C. Lefferts is president; Henry Rawle, W. E. Pulis and Nathan M. Clark are vice presidents; Carleton Montgomery is secretary and treasurer, the directors comprise in addition to the officers, Newcomb Carleton, Jos. Larocque, Edw. Van Volkenburgh, of New York,

and J. W. Clark, G. G. Freylinghuysen, W. D. Vanderpool and Henry Young, Jr., of Newark.

Perfection and commercial application of a method of making celluloid without the use of camphor, either the refined natural product or the synthetic material based on turpentine, recently was announced to the stockholders of the Celluloid Company by President Marshall C. Lefferts.

The announcement was made as a feature of the company's golden anniversary, which also is the semi-centennial anniversary of the connection of William G. Lindsay, chief chemist, with the company, the new process having been developed under his direction through experiments which have been in progress for the past fifteen years.

Popularly and commercially, objections to celluloid and its imitations have been raised because of the odor and taste imparted by the camphor or camphor substitutes used in the formula, and likewise to the inflammability of the product.

The elimination of both natural and synthetic camphor from the new formula is declared to eliminate also both taste and odor, and to reduce inflammability by from fifty to eighty per cent., making the product a slow-burning one instead of one readily consumed by fire. Numerous examples of the new product bear out the claim that it has neither taste nor smell, this being an important consideration in the use of the product for such articles as pipe-bits and tooth-brushes.

While the claim is not made that the new formula provides a cheaper product, it is stated that this may be a development of the process, in view of the fact that no changes in machinery or equipment for its manufacture are involved.

Both in the sheet, or raw material form, and in manufactured articles of use, the camphorless product has the same appearance as the older form,



Plant of The Celluloid Co., at Newark, N. J.

having the same degree of pliability and being capable of the same high polish. It takes color more readily, however, requiring some modification of coloring processes, and has a higher degree of transparency in the translucent form. It has been used both for thin sheets, in the ivory and tortoise-shell forms, and for the heavier "artificial ivory" product.

It is not claimed that the new formula is adapted as yet to all uses for which celluloid is employed, but it is stated that experiments, continuing to this end, promise desired results.

Synthetic camphors, developed in Germany, were widely used in celluloid, or pyroxalin, manufacture before the war, due to the soaring price of the natural gum camphor, which, then controlled by the Japanese, had risen more greatly in cost during and since the great war. The isolation of Germany by the war cut off the source of supply of

this cheap substitute, and many of the American pyroxalin manufacturers as a result of experiments have developed synthetic camphors of native manufacture, all of these being based on turpentine.

The process developed by Mr. Lindsay and John H. Stevens, of The Celluloid Company chemical staff, is stated to have no turpentine base, the turpentine product, like that involving the use of gum camphor, being inseparable from some degree of odor. The new process is declared to be based on an entirely different principle, the camphor content, natural or synthetic, being replaced by an adaptation of a material originally developed in Germany some years ago, but never successfully applied until now to this purpose, and never extensively made or used. It is not claimed that the discovery involves the finding of a new body, the novelty being in the method of applying the substitute to the manufacture of the final product.

Behavior of Commercial Sugar Solutions

One of the large branches of the sugar industry is the manufacture of syrups for direct consumption. If the syrup consists only of sucrose, the saturated solution may contain only 68.7% of the sugar. Such a solution is too thin for a desirable product and is susceptible to fermentation. If concentrated to a denser consistency, it becomes supersaturated and deposits sugar crystals. If, however, the sucrose is partially inverted, the density may be considerably increased, but if the inversion is carried too far, the relatively low solubility of dextrose limits the density to which the syrup may be concentrated.

A study has been made by the Bureau of Standards of the mutual solubilities of the three constituent sugars, namely, sucrose, dextrose, and levulose in the presence of each other. Equal proportions of dextrose and levulose in solution constitute "invert sugar" which is formed by the inversion of sucrose. The solubility of sucrose in varying proportions of invert sugar was determined by very high concentrations of the latter. Similarly, the solubility of sucrose in the presence of dextrose, and of dextrose in the presence of sucrose, and finally of dextrose in the presence of levulose were measured. With the exception of some measurements on the solubility of sucrose in the presence of invert sugar, no determinations of these solubilities have previously been recorded.

The results of this investigation have shown the maximum concentration which invert sugar may have without depositing crystals of dextrose, and similarly the maximum concentration which a mixture of sucrose and invert sugar may have without depositing either sucrose or dextrose. The syrup which contains 33.7% of sucrose and 44.8% of invert sugar, or a content with respect to total sugar of 78.5%, has this maximum concentration. In general, it is practicable to increase this concentration even to a slight supersaturation without danger. Such a solution is sufficiently dense for a good syrup and resists the growth of micro-organisms.

National Chemical Products Company, formerly of 120 Liberty street, New York City, have removed to a much larger suite of offices at 135 William street.

Corn Products Refining Co.

The Corn Products Refining Co., in its report for the first three months of 1920, shows net earnings, after deduction of all charges and Federal taxes, of \$5,164,519. This compares with \$2,442,300 for the same period of 1919 and represents an increase of 108 per cent. After deduction of preferred dividends there is a balance equal to \$9.20 on the common, or at the rate of nearly 37 per cent. annually.

The company's excellent exhibit of earnings is due in great part to the demand for its products caused by prohibition and sugar shortage.

To meet the urgent call for its products the company announces that it will build a new refinery in the Middle West which will cost between \$7,000,000 and \$8,000,000. The new refinery will have a capacity for grinding 25,000 bushels of corn daily. Present output is 150,000 bushels so that with the new plant in operation a total grinding capacity of 175,000 bushels a day will be reached.

Armour & Co.

Armour & Co. will acquire the controlling interest in the Jarecki Chemical Co., owning and operating plants for the manufacture of fertilizer in Cincinnati and Sandusky, Ohio. The outstanding stock will be purchased by the Armour interests at \$250 per share of \$100 par value. The Jarecki Chemical Co. has recently made arrangements for the enlargement of its plant at Sandusky, Ohio, upon completing the work of rebuilding its plant in Cincinnati, which was destroyed by fire some time ago. Gustave Jarecki, Jr., president of the Jarecki Chemical Co., said the deal is under negotiations but has not been consummated as yet.

The Los Angeles municipal cement plant at Monolith, Cal., has been leased by Portland, Ore., interests for a 5-year period at an annual rental of \$225,000. The plant, built at a cost of \$800,000 at the time Los Angeles built her water supply system, has been idle for seven years. It will be used by the lessees for a potash recovery process and machinery costing \$150,000 will be installed.

The Amalgamated Dyestuff & Chemical Works, Inc., has increased its capitalization from \$500,000 to \$1,000,000. Extensions to its plant at Newark, N. J., costing \$150,000, are in process.

Government Plans of Operation of Nitrate Plant No. 2

By Arthur Glasgow

The war has demonstrated beyond dispute that no nation is safe which is dependent upon a foreign supply of nitrogen. National security demands an adequate domestic supply of high explosives, the consumption of which in modern warfare has been found vastly to surpass all expectations. The cause of the Allies was in constant jeopardy because of the necessity of importing nitrates from Chile; it does not need Lord Fisher's recent articles regarding the future of submarine warfare to demonstrate the uncertainty of importing military supplies; but, while the fundamental requirement of national defense demands self-sufficiency in explosives, this necessity places the United States in a position of some comparative advantages, because only nations able to provide an adequate supply of fixed nitrogen can wage successful war against the United States.

The capture of atmospheric nitrogen in efficiently utilizable form is a new and undeveloped art. Unless the United States nitrate plants are brought into continuously developing service they and their products are likely to be obsolescent and useless in the strenuous competition of future warfare. The only way to secure that these plants shall be always immediately available for most efficient military service and for most efficient and economical extension in case of need is to operate them continuously, whether in peace or war. Fortunately, from this point of view, nitrogen is as essential in peace as in war. It is as necessary to preserve life as to destroy life; and nitrogen is the most expensive component of standard fertilizers.

The following discussion describes how the Government proposes to maintain and continually enhance the military value of United States Nitrate Plant No. 2 at Muscle Shoals, while substituting its peace-time output for imported nitrogen compounds on terms highly beneficial to American agriculture. This will be accomplished not only without additional cost to the United States but while earning interest on about one-half of the total war cost of this plant and accessories.

The proper utilization of the smaller United States Nitrate Plant (No. 1) at Sheffield has not yet been determined.

The consideration of the Muscle Shoals plant covers three progressive stages:

Firstly, the period prior to June 1, 1921. During this period we have to pay an operating fee to the Air Nitrates Corporation equivalent to \$5 per short ton of ammonium nitrate produced (say, \$2.48 per ton of dry cyanamid), and, in addition, a royalty of \$2.53 to American Cyanamid Co. and a royalty of 57 cents to the Air Reduction Co. per ton of dry cyanamid produced.

Secondly, the period from June 1, 1921, until the completion of the hydroelectric power development. During this interim the operating fee is no longer payable, and the royalty payable to the American Cyanamid Co. (nominally about \$6.33 per ton of dry cyanamid, or 26 per cent more than the combined operating fee or any royalty previously payable) is subject to arbitration. Inasmuch, how-

ever, as royalty is measured by superearning power, it seems certain that little if any royalty would be assessed for the use of a process which does not pay Government bond interest upon the reproduction value of the essential plant required.

Thirdly, the continuing period of cheap water power subsequent to the completion of the hydroelectric development. During this future period we shall have not only the relief from royalty due to arbitration, but the more positive relief due to expiration of patents. It is to be noted that the Air Reduction Co.'s royalty of 57 cents per ton of dry cyanamid is payable until January 13, 1931.

Inasmuch as there is no considerable present market for the nitrogen products of the Muscle Shoals plant as it now stands, namely, for cyanamid and ammonium nitrate, it is essential to adapt the plant to the manufacture of a product which is immediately saleable in large quantities, in order to carry the burden of slowly building up a demand for these less saleable products; otherwise, the operating and overhead expenses of this great plant will swamp the enterprise financially before markets can be developed for these products.

To this end the manufacture of sulphate of ammonia is the most efficient means; and in the Tennessee Copper & Chemical Corporation we have a neighbor who is urgently in need of purchasers of large quantities of sulphuric acid, not to speak of sulphuric acid manufacture on our own account. We, therefore, recommend the installation of a neutralizing plant for the manufacture of 110,000 tons of sulphate of ammonia per annum, being one-half of the total capacity of the plant, together with co-ordinate storage and other facilities, at a total structural cost for this sulphate department of about \$1,500,000. This is considered later in dealing with new construction for peace-time operation.

It is convenient to reckon the capacity of the Muscle Shoals plant by the number of carbide furnaces in use. There are 12 furnaces altogether, each capable of producing carbide for 22,225 tons of dry cyanamid per annum. At full capacity of plant, 10 of these furnaces are working, two being always in reserve for repairs, etc. The local steam power plant at present capacity will operate eight of these furnaces, and inasmuch as power brought from the Government's unit at the Warrior River Station of the Alabama Power Co. is unduly expensive, it is not intended to operate more than eight furnaces (or 80 per cent of the total capacity of the plant) until the cheap hydroelectric power is available.

Our present expectation is to utilize the capacity of eight carbide furnaces approximately as follows:

Four furnaces (or 40 per cent of plant capacity) for the manufacture of 86,000 tons of ammonium sulphate;

One furnace (or 10 per cent of plant capacity) for the manufacture of 22,225 tons of dry cyanamid—making 24,445 tons of hydrated and oiled cyanamid;

Two furnaces (or 20 per cent of plant capacity)

for the manufacture of 22,000 tons of ammonium nitrate;

One furnace (or 10 per cent of plant capacity) for the manufacture of cyanamid, ammonium sulphate, ammonium nitrate, or intermediate product according to demand.

When the hydroelectric power is completed, the remaining two furnaces will be applied to the manufacture of the then most advantageous product, possibly ammonium phosphate.

Meanwhile every effort will be made to cultivate the use—firstly of cyanamid, and secondly of ammonium nitrate, in preference to ammonium sulphate; because the cost per unit of nitrogen is much less in those forms than in the form of ammonium sulphate.

To ascertain the financial results of the general plan of operation outlined above, we must figure in terms of ammonium sulphate, that being a readily saleable commodity of well standardized value. The pre-war price of ammonium sulphate was about \$60 per ton; it is our best judgment that the post-war prices will average over \$70 per ton. (See pl. 17.) Sulphate of ammonia contains about 20.6 per cent and dry cyanamid about 21.1 per cent of nitrogen; whereas ammonium nitrate contains nearly 35 per cent, or more than double the nitrogen content of sodium nitrate from Chile. Moreover, cyanamid contains over 60 per cent of lime, which is a valuable fertilizer in many soils. On the basis of nitrogen content alone, with sulphate of ammonia selling at \$70 per ton, hydrated and oiled cyanamid (containing 19.2 per cent of nitrogen) would be worth \$65 and ammonium nitrate would be worth \$117.50.

Unfortunately, the toxic features of cyanamid, combined with its other disabilities and the hygroscopic qualities of ammonium nitrate, interfere with their use for fertilization, as fertilizers are now manufactured and applied. It is, therefore, necessary to give the farmers and fertilizer manufacturers a sufficient reduction in price to induce them to take the trouble to overcome these disabilities.

In view of the fact that within three years we expect to have available hydroelectric power for the full capacity of the plant at an operating and maintenance cost (excluding interest on investment) of 0.75 mill, instead of the present steam-power cost of 4 mills per kilowatt hour, we recommend the initial sale of cyanamid at \$45 and of ammonium nitrate at \$100, compared with sulphate of ammonia at \$70 per ton. At this scale of prices a unit of nitrogen in the form of ammonium sulphate would cost 45 per cent more than in the form of cyanamid, or 17½ per cent more than in the form of ammonium nitrate.

In other words, we should say to the farmer and to the fertilizer industry:

"We cannot sell you ammonium sulphate at less than the market rate, governed by the law of supply and demand; but if you are willing to take the trouble to use your nitrogen fertilizer in the form of cyanamid or ammonium nitrate, we can make you immediately the very great savings described above. We, for our part, undertake to remove the physiological disadvantages of cyanamid by hydrating and oiling, and to relieve the hygroscopicity of ammonium nitrate by coating; and we expect to make further reductions in the prices of cyanamid and nitrate when cheap water power becomes available."

Having established the probable selling prices, we must now know the probable costs of the several products in the three periods described in the beginning of this discussion.

Prior to June 1, 1921, if operating continuously, eight of the carbide furnaces (or 80 per cent of the ultimate capacity of the plant), the costs per ton would be as follows:

	Cyanamid (hydrated and oiled).	Nitrate	Sulphate
Production costs	\$29.02	\$80.48	\$49.45
Bagging expense	1.75	2.00	.50
Sales expense	1.15	3.08	1.87
Research and Washington Office	.95	2.55	1.54
Cost of product.....	\$32.87	\$88.11	\$53.36

To these must be added royalties and fees to June 1, 1921, as follows:

	Cyanamid (hydrated and oiled).	Nitrate	Sulphate
Royalty to Air Reduction Co.....	\$0.52	\$1.16	\$0.69
Royalty to American Cyanamid Co.....	2.30	5.11	2.62
Operating fee to Air Nitrates Corporation.....	2.25	5.00	2.56
Total	\$5.07	\$11.27	\$5.77
Total steam-power costs prior to June 1, 1921.....	\$37.94	\$99.38	\$59.13

For the middle period, from June 1, 1921, until water power is available (say until December, 1922, or 18 months), we may add 10 per cent to "Cost of Product" for the first period, in substitution for operating fee, royalties and contingencies, making:

Total costs from June 1, 1921, until power is available:			
Cyanamid	\$36.16		
Nitrate	96.90		
Sulphate	58.27		

When water power becomes available at 0.75 mill per kilowatt hour, and with all royalties eliminated, the respective

Water-power costs will be:

Cyanamid	\$24.57
Nitrate	68.50
Sulphate	43.81

The royalty payable to Air Reduction Co. until 1931 is:

Cyanamid	\$0.52
Nitrate	1.16
Sulphate	.59

The nominal royalty to American Cyanamid Co., after June 1, 1921, is:

Cyanamid	\$5.75
Nitrate	10.40
Sulphate	6.18

But this is subject to arbitration and to the lapse of patent rights.

It is believed that 10 per cent. added to the above "Water-Power Costs," to cover all the contingencies, including royalties, will provide a proper margin of safety. This makes the Inclusive Water-Power Costs:

Cyanamid	\$27.03
Nitrate	75.35
Sulphate	48.19

It must be borne in mind that the estimates of cost for the first two periods, ending when water-power becomes available (say, December, 1922), are based upon the continuous operation of eight carbide furnaces, or 80 per cent of the ultimate capacity of the plant. It is obvious that a new industry of these huge dimensions will not thus spring into being; the creation of this unique manufacturing organization and the marketing of this

great output must be matters of careful and gradual growth. In fact, this growth will doubtless continue until the water-power becomes available, before reaching the full 80 per cent capacity of the present steam-power plant.

For this reason, the figures for steam-power costs in the first and second periods are academic rather than practical; they are useful as illustrating the great advantages attaching to cheap water-power, rather than as a measure of profit and loss during the initiation of the business. In common with the creation of any new industry, the Muscle Shoals enterprise must sustain initial losses. These are provided for by the "General Purposes Fund" described later.

For any useful conclusion regarding the future financial possibilities of the plant, we must look to the permanent water-power costs, subsequent to say January 1, 1923.

Taking the "Inclusive Water-Power Costs," given herebefore, and reducing the selling prices of cyanamid, ammonium sulphate, and ammonium nitrate respectively to \$37.50, \$65 and \$90 per ton, we have the following balance sheet, with eight furnaces, or 80 per cent of the capacity of the plant, in operation:

	Tons per annum	Cost	Per ton sale	Profit	Total profit
Cyanamid	49,000	\$27.00	\$37.50	\$10.50	\$514,500.00
Nitrate	22,000	75.35	90.00	14.65	322,300.00
Sulphate	88,000	48.20	65.00	16.80	1,444,800.00
Annual profit for 8 furnaces (80%)					\$2,281,600.00

Balance sheet when whole plant is in operation:

Cyanamid	73,500	27.00	37.50	10.50	771,750.00
Nitrate	22,000	75.35	90.00	14.65	322,300.00
Sulphate	107,500	48.20	65.00	16.80	1,806,000.00

Annual profit for 10 furnaces (100%)

This \$2,900,050 is 5 per cent interest on \$58,000,000; while ammonium sulphate at \$65 per ton (instead of \$70) still costs 61½ per cent more, per unit of nitrogen, than cyanamid at \$37.50 per ton, and 21½ per cent more than ammonium nitrate at \$90 per ton.

To adapt the present plant, which is built exclusively for the production of ammonium nitrate for military explosives, to the manufacture and sale of cyanamid, ammonium sulphate, ammonium nitrate, and intermediate products, will require the following new construction and equipment, in addition to some \$1,000,000 which must yet be expended for military purposes out of present funds:

Oiling and hydrating equipment for 200 tons of cyanamid daily	\$150,000
Sulphate of ammonia plant, buildings, and equipment, capacity 300 tons daily	900,000
Storage and bagging for all products, buildings, and equipment	450,000
Acid storage, capacity 20,000 tons	300,000
Tank cars, shipping containers, sidings, and miscellaneous	400,000
Stores (merchandising) for employees	100,000
Office building	100,000
Reserve for extensions and betterments	600,000

Total fund for new construction

The working capital required for 10 furnaces, or full capacity of plant, will be:

Stocks for raw materials and supplies	\$1,600,000
Stocks of manufactured products	2,500,000
Excess of bills receivable over bills payable	2,000,000
Cash	300,000

Total working capital

A "General Purposes Fund" will be required to provide (a) for the payment prior to June 1, 1921, of operating fee and royalty, and (b) for the expense of creating the organization and the business starting at nil. Both (a) and (b) are to be charged to "Good Will," which will be carried as an asset account until it is extinguished by profits. The

money will thus be restored to "General Purposes Fund," to be used for improvements and betterments and in emergencies, in view of the fact that we shall not have the usual right of corporations to borrow money in case of need.

To summarize, we recommend the promotion of a bill in Congress for—

New construction	\$1,000,000
Working capital	6,500,000
General purposes fund	2,500,000
Total appropriation	\$12,100,000

This will realize the utmost peace-time advantages of the war investment of \$70,000,000 in United States Nitrate Plant No. 2, and of the current investment of \$18,000,000 in hydroelectric and navigation development; while, at the same time, it will promote national security by making this plant always the most advanced example of the art—supplying current military requirements, and a model for efficient multiplication in case of need.

In addition to granting the necessary funds, namely, \$12,100,000, as above, Congress should give us authority to conduct these extraordinary operations so as to utilize the existing plants and this new money with the highest possible efficiency. In other words, we should have authority to establish the administrative organization which will give the best results in such an enterprise. My original memorandum of January 7, 1919, dealing with this subject, expressed the unanimous opinion of all concerned that such an undertaking could not be properly administered by the Army; and my original recommendation was that the fixed-nitrogen administration should be a self-contained bureau of the War Department, under the immediate control of the Secretary of War, but quite independent of the Army. This recommendation was then expanded to include interdepartmental control. But we now revert to my original advice, with the important exception that the fixed-nitrogen administration should be incorporated instead of being a bureau of the War Department.

In other words, we recommend that a corporation should be formed to take over all of the fixed-nitrogen assets of the War Department, together with the funds obtained from Congress, and to perform all of the duties of administering these plants and funds in peace time, while continually enhancing their military value. There could be a nominal amount of common stock, of no par value, issued to the United States and held by the Secretary of War, in exchange for the fixed-nitrogen assets of the War Department, and 5 per cent preferred stock could be sold to the United States at par, from time to time as required, to provide the necessary additional funds of \$12,100,000 described above. The Secretary of War would be chairman of the board. All of the officers and directors would, of course, be appointed and removable by the Secretary of War.

This plan would preserve to the Secretary of War his complete control of the undertaking, while giving the responsible officials of this independent agency full executive and administrative freedom in the pursuit of efficiency.

Lever Bros. Co., of New Jersey, is a recent incorporation, with 167,000 shares without nominal value, by F. A. Countway, president of Lever Bros. Co., Boston, Mass., Henry V. Poor and Donald C. Muhleman to manufacture and merchandize linseed oil, agricultural products, etc.

The Business of Radium

By Hamilton Foley,

Standard Chemical Co., Pittsburgh, Pa.

The United States is the foremost radium producing country in the world. This ascendancy has been gained notwithstanding that five hundred tons of American ore is required to produce the one gram of radium that has been obtained from five or six tons of European ore. A gram is about a thimbleful.

The recovery is made with regularity and precision. In the different steps in the process and in even the most general statement of the difficulties that have to be overcome, there is a new chapter of American contribution to chemical progress. There is also much to show why the market price of radium is \$120,000 a gram.

The radium ore fields of the United States are in the southwestern part of Colorado and southeastern Utah. They cover a territory of about eight hundred square miles. This district is about sixty-five miles from any railroad and so mountainous that in many places there is a rise or fall in the local trails of two thousand feet in a mile.

Prior to the World War carnotite ores from these Colorado deposits were shipped abroad for French and German production of radium on a small scale. The embargoes on shipping stopped this export completely, although it had been falling off in quantity.

The recovery of radium in this country, as a commercial proposition, began in 1911, when the Standard Chemical Company, of Pittsburgh, was organized by Joseph M. Flannery, for the express purpose of mining carnotite ores and producing radium. Up to the present time it has produced almost one-half of the estimated supply of radium in existence.

Transport of Radium Ore

The infinitesimal radium content of the ore, making necessary the handling of enormous volume and weight of ore, the remoteness of the deposits from civilization and the long freight haul from Colorado to Pittsburgh, enforced efficiency methods to a high degree. Pack animals transport the hand-sorted ore in 100 lb. bags from the various chains to the concentrator. Here high grade ore is separated from ore of quality uneconomical to remove as such from the ore district. Milling reduces 500 tons of the hand-sorted ore to 125 tons in a pulverized condition, containing about 4 per cent of uranium oxide. The concentrate in 100-lb. bags is transported by wagon, train or motor truck 65 miles to a railroad at Placerville, Colo.; thence 2,500 miles to Canonsburg, Pa., near Pittsburgh, where the Standard Chemical Co. operates a reduction plant for the recovery of the radium, uranium and vanadium.

The vanadium finds a ready sale as an alloy for high speed tool steel and the experimental work being done with it as an alloy for use in other classes of steel suggests that it may be more generally adopted.

Reduction

The chemical treatment of carnotite concentrates at Canonsburg, involves greater difficulties than the

collection and first concentration of the ore. In part these difficulties inhere in the treatment of an exceedingly finely divided material; in greater part, they involve working out efficient processes for the recovery of a material present in so small a proportion as one part in a hundred million, this being, approximately, the concentration of the radium in these concentrates. As they are further reduced chemically these concentrates yield what is called "raw sulphate." This consists, essentially, of silica together with sulphate of radium, barium, calcium, iron and aluminum. After freeing this mass from impurities and transforming to a soluble salt, there is obtained a soluble radium chloride.

Plant Control

The reduction plant keeps trace of the minute modicum of radium in the ore in process of reduction by the application of the most refined scientific measurements known. These measurements make it possible to know just where and in what quantity the radium is at all stages of the work. Remembering that when it reaches the reduction plant there is only one portion of radium for every hundred million portions of ore and that if this small quantity is not watched for very closely it may be lost and with it all the expense that has attended the shipment of five car loads of ore all the way across the continent, the details by which it is followed may not be without interest. Every day the reduction plant sends to the laboratory at Pittsburgh, samples of each batch of ore it is proposed to handle for the first time that day, samples of each batch of ore in each stage of the reduction process and samples of each batch of residue it is proposed to discard. Chemists reduce these to solution. If there be any radium in any or all of these solutions it will generate the gas known as radium emanation. Inasmuch as this emanation emits the rays emitted from radium and as these rays carry electrical energy, each sample in turn is placed in an electroscope so the electrical energy it may liberate may be ascertained.

The electrical energy from equal quantities of radium is always the same by comparison, therefore, of the electrical energy obtained from any one of these samples with that obtained from a known quantity of radium, it is a matter of accurate calculation to know the quantity of radium in the batch of ore represented by the sample.

While scientifically trained minds know that the emanation from a gram of radium is not larger in volume than the head of a pin, it may surprise some readers of the Chemical Age to know that the measurements described detects with extreme accuracy quantities of radium as small as a billionth of a gram, or one five hundred millionth of a pound avoirdupois; and that such extremely minute measurements are made not once but sometimes twenty and even thirty times a day in the laboratory of the Standard Chemical Company.

Radium Products

In the form of radium barium chloride the one-half ton of concentrates that is left after the

Canonsburg reduction plant has eliminated the rest of each mass of five hundred tons of ore, is brought to the laboratory at Pittsburgh. Here by successive fractional crystallizations of the radium chloride, and at a later stage, of the bromide, most of the radium is obtained in a salt containing over 90 per cent of pure radium bromide. A second or smaller amount of radium in the form of a salt of five to ten per cent. purity is also obtained. By further chemical treatment the bromide is converted into the sulphate or the chloride and in the therapeutic use of radium these two salts find the largest use. The lower grade material, because of greater ease in handling and weighing out small portions with a definite radium content, finds use in the commercial world in the manufacture of the radium luminous compound more popularly known as luminous paint.

Volume of Production

The first radium obtained in the United States was obtained in 1913 in the laboratory of the Standard Chemical Company. Since then the production of this company has been as follows:

	Grams (Radium Element)
1913	2.1
1914	9.6
1915	1.7
1916	5.0
1917	7.0
1918	13.6
1919	11.8
Total	50.8

Writing of the production of radium by this company, a scientific writer has recorded the opinion that:

"In the midst of industries whose output is measured in thousands or millions of tons, an industry whose total output in nearly five years is about one ounce, is likely to seem small, yet this production of radium by the Standard Chemical Company of Pittsburgh is the most notable in the world. This is more than a third of the estimated stock of the world's high purity radium, and to the efforts of this one company belongs the credit of starting and so establishing the manufacture of radium from low grade ore so that the medical and scientific professions may count upon an ever increasing supply."

In the ore fields the Standard Chemical Company maintains a force of several hundred men. Nearly as many are required at the plant at Canonsburg. In the laboratory at Pittsburgh there is another large staff. The activity of all of these men is necessary to make it possible for the radium in any quantity of ore to be obtained about three months from the time the ore was first mined.

Radium Standards

Radium preparations in the United States are spoken of and measured in terms of radium element. Until recently European scientific men have adhered to the term radium bromide. Crystalline radium bromide when pure contains only 53.6 per cent. of radium element. This fact and the method of measurement of radium preparations in Europe prior to the adoption of an international radium standard, had not a little to do with the earlier unsatisfactory work with radium. There was no common standard. The original method of measuring

radium, consisted in comparing its activity with that of uranium. During the fourteen years this system of measurement prevailed scientific men spoke of radium as "two million times more active than uranium." Trained minds, of course, understood that what was meant was that the quantity of electrical energy emitted in the rays of the radium, small though it was, was two million times greater than that contained in the rays from uranium. Such a ratio of comparison was entirely unsuitable for use especially with small quantities, and about 1912, by common consent, Madame Curie was asked to prepare what would be an international radium standard. This is deposited at Paris. Duplicates are in the leading capitals of the world, and radium preparations are now measured by comparing the electrical energy carried by the gamma rays from the preparation to be measured with the energy carried by the gamma rays of the international standard, or one of the certified duplicates of it. In 1914, the United States Bureau of Standards at Washington obtained a certified duplicate of the international radium standard and practically all quantities of radium in this country have been measured by comparison with it.

Uses of Radium

In the industrial world interest in radium has always been limited by the small amount available. This was especially true of the ten years following its discovery. During that period some attempt was made to use the action of radium in causing a spontaneous and continuing luminescence in substances such as zinc sulphide, to make what is called luminous paint. In the United States attempts were also made to manufacture a similar product, but prior to 1913 this effort was practically negligible.

Radium and radium minerals are not generally luminescent. Tubes containing radium glow from impurities present which the radiations from the radium cause to give light. The World War created a most unexpected demand for radium. The necessity of illumination that would not betray presence to the enemy in the various branches of the fighting service made radium luminous material the most satisfactory and dependable light. The demand for the luminous watch dial alone raised one use for this material to a fair-sized industry.

Radium Therapy

Therapeutically, there has been a gradual and steady increase in the use of radium since 1912. With this increased demand the production of radium has kept pace. The earlier over-enthusiastic statements of the value of radium in the treatment of cancer have not been wholly confirmed and radium is far from being the panacea in the treatment of diseases. Nevertheless the use of radium in certain types of advanced inoperable cancer gives palliation by the relief of pain and freeing from foul smelling discharges. This degree of palliation can be attained by no other treatment and, if used for this purpose alone, radium would be considered invaluable. In other types of cancerous growths radium has produced cures and surgeons throughout the world are gradually admitting that radium is a necessary adjunct in the treatment of cancer, giving in some cases more satisfactory results than any other treatment.

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A Consolidation of
The Chemical Engineer
and Chemical Age



Announcement

THE CHEMICAL ENGINEER and CHEMICAL AGE have been consolidated by our purchase of the latter publication. The amalgamated publications will appear as one under the above name.

Lloyd Lamborn continues as editor.

Mr. Lamborn's training and experience as a chemist and as an author in applied chemistry, his practical sense and insight into the chemist and his work, his appreciation of the role of the business chemist in industrial progress and the place of the business of chemistry in our industrial system, has given to CHEMICAL AGE an originality and alertness that made for it an immediate place.

This amalgamation means growth.

The union provides opportunity for prompter realization of the ideals which inspire the publication and insures to all who make their living in the chemical and allied industries a service that, adequately to the importance of the field, never has been performed.

In this new dispensation my representations are simple.

I shall co-operate to the fullest with my organization to give to the chemist, the chemical engineer and to the business man who, out of the sale of their products, make possible the expansion of a wonderful industry, a live, growing, informative and inspiring publication.

I have a sense of responsibility for the quality of the service which we shall provide.

I feel that your criticism and help in our reciprocal relations are assured to the end that CHEMICAL AGE shall continue to be an intimate and engaging

reflection of progress in the art and business of chemistry.

ROBERT H. MCCREADY

* * *

EFFORTS of conflicting interests to enact dye-stuffs legislation that would insure safety from German competition, for the present have come to naught.

The transfusion of political issues into an economic subject led to a partisanship wherein the superior vested interests dominated, to the sacrifice of the question of preparedness or the protection and encouragement of a superlatively important infant industry.

The character-baiting and motive-perverting of political controversy always can be expected when a distinctly economic measure is subjected to the exigencies of a political theory, to say nothing of the hazard that at an inopportune moment some friend may be careless with the monkey-wrench.

This experience of chemical financiers and dye manufacturers to procure from politicians a measure of protection consistent with all interests involved, and with which the people are in sympathy, inculcates the lesson that they should have gone to the people with the problem in the first place.

Not only would they have got what the national instinct of self-preservation favors, but in the process an independent American dyestuffs industry would have been "sold" to the American people.

* * *

SOCIETY disregards ancient rules of conduct inapplicable to present conditions, or present rules which public opinion will not support.

Technology, particularly in the public utility of gas manufacture, cannot so disregard statutes passed originally in the public interest, but which in the swift growth of applied science and the kaleidoscope of economic change, not only are now subversive of the public interest in the uselessness of their requirements, but impose a needless burden of production cost that cripples financially the utility and hence its ability to serve the public.

The inconsistency of such conditions are so obvious to technical men that prompt response should greet the appeal to them that they become foci of infection to educate their immediate public to the injustice, under present conditions, of the obsolete candle power requirements for the sale of illuminating gas.

Public indifference to the handicaps that beset a public servant only can injure the public.

Colonel Fogg's resumé, in this issue of Chemical Age, of the evolution of gas manufacturing processes and the influence upon a great public utility of the present petroleum shortage, should impel technical men to preach the inherent justice to both the public and the servant, of the British Thermal Unit standard for the measurement of artificial gas.

IT is a commonplace observation that crises breed men sometimes big enough to fill a lasting place in the annals of the time.

The candidacy of a chemical executive for the gubernatorial nomination of the State of New York, on a platform of individual and national efficiency, justifies the hope that the present era of almost revolutionary change may throw up a technical man with the instinct of and capacity for leadership.

However qualified Elon H. Hooker may be to reconcile the business capacity and technical ability demonstrated in the creation of a great chemical industry, with the shiftiness of the professional politician, there is no doubt of his qualifications for the office of governor, and the need therein of a man of his calibre.

Rarely do democracies decorate with the laurel of political preferment their really capable men. It is the mollifier and the mixer who is crowned. The efficiency expert never is popular. The masterly man must give way to mediocrity that the people may rule.

Mr. Hooker deserves a great deal of credit—in fact, he should be supported for his temerity to prove that a technical man can be a politician as well as be worthy of the governorship of the State of New York.

* * *

GROVER CLEVELAND on one occasion laid down the principle that it is proper to support government but unwise to expect government to support us.

The National Association of Manufacturers at its silver jubilee convention promulgated a "platform for American industry," in which the same principle is emphasized as follows:

"As it is not the function of our government to own or operate industry, but to protect and encourage its legitimate development under private ownership and management, it should abstain from competition with its own citizens in any form of business which they can successfully undertake."

It should make the judicious among technically educated men grieve that among their number are a few men in high places in government service and as teachers of youth, who are infected with the Bolshevik virus.

In this issue of Chemical Age is an outline of the plan urged by these men for the government to engage in private enterprise in the chemical industry.

The business chemist should write to the secretary of the Senate Committee on Agriculture and Forestry for complete reprints of the hearings recently had on the production of atmospheric nitrogen.

They are not only a text-book on the development of a great art, but a discussion of economics in the chemical industry.

THE annual induction into industry of its technically trained recruits is now in progress. The demand for directive and creative capacity in production and trade assures their rapid absorption in those positions, wherein is determined their fitness for growth.

The translation of the young technical professional man from a parasitic, academic environment to one of self-supporting independence, wherein his effort is justified only as it can show profit to the organization, calls for a degree of adaptability, wherein will be reflected the measure of the man.

To do what you are told to do and to do it cheerfully, quickly and in a way better than is expected; to study your co-workers as intently as you study industrial processes, that their respective deficiencies may be supplied by your alertness; to try to learn the boss's job as well as he knows it but with no sacrifice of loyalty to him, or of efficiency in your work; to set your mind upon a place and qualify yourself to fill that place, for experience teaches that opportunity to do so sooner or later will come; with eyes always open and circumspect of speech, but never niggardly of help to others; all these are practical suggestions to the technical novice that older men will tell him surely will get him somewhere along that devious road that leads to a contented mind.

Is it asking too much of erring human nature to admonish him to disappoint, neither the men who for four years have tried to bring out the best that is in him, nor that patient figure, with hair flecked with silver, who knows him better than he knows himself?

* * *

HOWEVER true may be the charge that we are a nation of economic illiterates, the response of the people to the preaching of thrift and increased production, belated and sporadic though it may be, demonstrates that advertising pays.

Cessation of retail buying at peak prices led to accumulated stocks which contraction of credit compelled spectacular distribution in many localities at reduced price levels.

Basic economic conditions as regards materials and labor in the production and transportation of food, clothing and shelter demonstrate the exaggeration and baselessness of expectations of any quick return to so-called normal conditions which, from the standpoint of business stability, would be fraught with extreme danger to our economic structure.

The stupendous suppressed demand, the world shortage of raw materials and the upper hand of labor will enforce a slow return to that equilibrium of production and consumption wherein the body of our people enjoy the maximum welfare.

The idea of thrift apparently has been "put over." To depend upon self-denial for increase of supplies, defeats the universal desire.

In the last analysis increased production is the only remedy; all other means should be marshalled to increase the things that are needed most.

Formic and Oxalic Acids in the Dyeing Industry

By Launcelot W. Andrews

Victor Chemical Works, Chicago

The dyer, in using acid dyes, has the choice of a wide variety of acids with which he may acidify his dye baths. In making his selection among them for each particular case, he should be guided by certain general principles, which may be briefly indicated as follows:

He will endeavor to choose an acid which will not tender the fabric; which will cause the dye to be evenly deposited; which will cause as complete utilization as possible of the dyestuff, and which will lead to as perfect a fixation of the dye upon the tissue as possible.

Now, to a certain extent, some of these objects are inconsistent with others. For example, the strong mineral acids, such as sulphuric or hydrochloric, lead to a perfect exhaustion of the dye bath and to a highly satisfactory fixation of the color, but, on the other hand, they weaken the tissue and are likely to cause an uneven dyeing. The aim of the dyer should, of course, be to steer a safe course between these two difficulties.

If he asks what is the distinctive characteristic of the acids upon which these desirable or undesirable properties depend, the answer must be as follows: Any and all of the acids that he may use produce hydrogen ions in the bath to which they are added, but some of them produce these ions much more freely than others. It is the hydrogen ions that tender the fabric; that cause the dye to combine with the fabric; and that do the other things mentioned, both those that are desired and those which are not wanted. The result attained either good or bad depends simply upon the hydrogen ion concentration of the dye bath.

For equal quantities of acid employed, a mineral acid will give a high hydrogen ion concentration; whereas a weak organic acid will give a far lower hydrogen ion concentration.

It follows from these considerations that the scientific dyer must select an acid which will not produce a sufficient quantity of hydrogen ions to tender the fabric or to cause uneven deposition of the dye, but will select one giving as large a quantity of these ions as possible, short of that injurious amount.

Acetic acid gives a very even dyeing with no tendering of the fabric, but the dye bath is in most cases not exhausted as to its dye and the color is not as firmly attached to the tissue as it should be. Both these things are due to the fact that in an acetic bath the hydrogen ions are not abundant enough.

Now there are many organic acids which are intermediate in strength, that is, in ion-producing power, between sulphuric acid and acetic acid. The measure of the relative ion-producing powers of the several acids is given indirectly by the so-called "affinity constants." Formic acid has an affinity constant about twelve times as great as that of acetic acid, and, consequently, comes into con-

sideration as a possibly desirable substitute for acetic acid.

As a matter of fact, previous to the war, formic acid was beginning to attract a good deal of attention abroad from this point of view. The comments made on the results practically attained are altogether favorable. Thus Knecht and Rawson in their "Manual of Dyeing" say: "It has also been recommended as a substitute for hydrochloric, tartaric and other acids in dyeing aniline black, in order to avoid all danger of tendering. For leather dyeing and deliming, it has proved extremely useful." Farrell* in the work "Dyeing and Cleaning," says: "It has many advantages over the latter (acetic acid). Its advantages are summarized as:

1. Better penetration.
2. More even dyeing.
3. Better exhaustion.
4. Brighter colors.
5. No increased cost.

It is entirely obvious that an extended use of formic acid in dyeing must depend not alone upon its adaptation to the work to be done, but, also, and no less, upon the question of relative costs. If as much formic acid, as of acetic, were needed for a given dye bath, the expense might prove to be prohibitive in many instances. Such, however, is not the case.

The lower molecular weight of formic acid, in conjunction with its greater ion-producing power, makes it possible to employ a much smaller amount of this acid than would be required of acetic acid. To render this point clear, the following table has been calculated, showing the relative quantities of the two acids requisite to produce identical acidification, that is to say, identical hydrogen ion concentrations.

TABLE OF HYDROGEN ION CONCENTRATIONS
FOR VARIOUS PERCENTAGES OF ACETIC
AND FORMIC ACIDS.†

1. H ion Normality	2. Formic Acid Percentage	3. Acetic Acid Percentage	4. Ratio
0.0001	0.0675	0.039	5.7
.001	.026	.339	13.0
.002	.095	1.35	14.12
.003	.206	3.02	14.62
.004	.362	5.36	14.77
.005	.560	8.37	14.95
.006	.80	12.04	15.05
.007	1.086	16.36	15.1

$N = \frac{H^+}{K} + H$. N = normality of the acid. Percentage is expressed as grams in 100 cc. of solution. H = normality of the hydrogen ion concentration.

Column 2 presents the percentage of formic acid that must be in the solution to produce the H ion concentration given in column 1. Column 3 gives the corresponding percentage of acetic acid required. Column 4 shows how many pounds of

*The following references may also be consulted: Green and Steens, Jour. Soc. of Colorists: 1904, p. 6; Kapff ibid. 106, p. 75.
†Research Laboratory, Victor Chemical Works, Chicago.

acetic acid are needed to make a bath having the same acidity, i. e., H ion concentration, as that produced by one pound of formic acid.

The figures are to be regarded as only approximate, but they are accurate enough for all practical purposes. They show that from twelve to fourteen times as much acetic as of formic are required.

These data would be subject to modification in some of those cases in which the dyestuff contains a mineral basic element, as sodium or calcium. But, even in these instances, the proportionality factor is so largely in favor of the formic acid as to render the use of the latter more economical than that of acetic acid.

Oxalic acid stands in an intermediate position between formic and sulphuric acids, being weaker than the latter and stronger than the former. In consequence of its being a bibasic acid, it behaves

like a mixture of a stronger acid with a weaker one. It has been found useful in some cases as a constituent of the dye bath.

One important objection to the use of either of these acids which formerly prevailed has now, happily, been removed. I refer to the inconveniences resulting from the circumstance that these acids had to be imported and that the user was subjected to domination by the foreign manufacturer and to his arbitrary exactions.

Both acids are now products of the American chemical industry.

The salts of formic and of oxalic acids, as well as the free acids, are of value to the dye man; for example, the formates of chromium and of aluminum and double oxalates of titanium with alkali metal, of antimony with alkali metal and of tin or molybdenum.

A Chemical Executive Seeks Service As Governor

The announcement of Mr. Elon H. Hooker as a candidate in the primaries for the Republican nomination for Governor of the State of New York should be received with satisfaction by every voter in the chemical and allied industries. If ability to help one's self qualify him for service to others, Mr. Hooker's well-known career as a successful business man in the chemical industry furnishes abundant evidence of his fitness for the Governorship.

Aside from the interest that every technical man should have in the political aspirations of a member of his tribe, Mr. Hooker is an example of Elwood Hendrick's preaching that the chemist should take an interest in politics. Not only are chemists rapidly proving their fitness for the directorship of chemical corporations, but with the enlargement of their economic horizon we may expect them to take an interest in politics, particularly when the chief figure can command that interest by ability demonstrated in the creation of a great enterprise out of an electrolytic cell.

Never in the history of our country has there been so great a need as at the present for conservative business leadership. That this demand can be supplied by the chemical industry with a platform of principles fundamental to all industry indicates the swift progress of events in a field once little known and its capacity for growth of leadership. Needless to say that chemists throughout the country will watch the growth of Mr. Hooker's



ELON H. HOOKER
President Hooker Electro Chemical Co.

candidacy or that the popular response in his own state to the principles he advocates will not be aided by those who know so well the "ins and outs" of a chemical plant.

The announcement of Mr. Hooker's candidacy, which follows, is replete with sound economics, sane statesmanship and that direct appeal to personal interest that one cannot escape:

I am under no pledge or commitment to any man or group of men. It is my purpose to appeal directly to the voters, outlining my conception of the needs of the State and definite plans for meeting them.

The main and most immediate problem is the cost of living, and linked with this is the widespread social unrest. These are the direct product of \$250,000,000,000 in wealth and 40,000,000 casualties expended in the war. There is no short-cut back to normal, any more than there is of suddenly replacing the 10,000,000 buried dead.

Inflation of the currency is a world and national contributing cause; and this has been accompanied by a more extravagant plane of living and an increased consumption of both necessities and luxuries. On the other hand, there has been a decrease in production—the vital factor in our restoration to industrial health. Decreased production means decreased earnings, shutdowns, decrease in extensions and further increase in the cost of living. The most vital need of the State is an administration which will seek by every power vested in the Government

to encourage, inspire and vitalize all ideas and practices tending toward increased production. This will put New York State in her rightful position of leadership in this predominantly important movement.

It is my belief that through the agency of the State, if its affairs are properly managed, these far-reaching and beneficial results may be secured:

1. Increased production, both in quality and quantity, on the farm and in the shop.
2. Elimination of dangerous radicalism by handling overt acts relentlessly under criminal law and meeting agitation with education.
3. Reduction in the cost of Government by cutting out waste without loss of efficiency.
4. Development of the State's resources to produce additional wealth over which to spread the tax burden.

These and all other State problems must be approached from the standpoint of the mass of the public rather than from that of any special class.

While some individuals and corporations have been guilty of profiteering, the mass of the people, if not made actually to suffer, have found the living problem increasingly difficult. The great middle-salaried class have been the particular sufferers. They have been overlooked or have not been in position to force recognition of their rights and their salaries have not kept pace with the rising cost of necessities.

The industrial worker wants and should have an adequate wage and a further participation where he increases the quality and quantity of production. Employers must stimulate the inventive and creative forces in men. This will open up stores of unsuspected wealth and produce minimum operating costs.

There should be a balanced development of industry and of agriculture, which furnishes eighty per cent. of the raw materials to industry. The farmers have many problems that the State must help solve, but we should remember that farmers are likely to have the best judgment on them and should seek their advice.

We must publicly discuss and teach widely sound, straight thinking. The truth made clear will break down unsound theories. Dissatisfaction and discontent are not confined to the unthinking. Even the better educated and more thoughtful classes of the community, seeing the effect of propaganda, radical agitation, strikes and other evidence of unrest, very properly wonder what the future has in store for the Nation, State, community and the individual.

Disregard of the public no longer should be tolerated by the State. The lawless, whatever the country of their birth, should be dealt with as enemies. Ninety-two per cent. of us are being abused in the conflict between capital and labor, although the latter is only eight per cent. of our people.

The war costs must be met but the riot of spending, both in Nation and State, should be brought to an end. State expenditures have more than trebled in twenty years. We are approaching an annual budget of two hundred million dollars. There are one hundred and eighty-seven departments, many with over-lapping functions which waste the taxpayers' money and harass business.

With the mounting cost of foodstuffs and clothing, rent and every other item that enters into life's

activities, the increased burden of taxation to meet the cost of government constitutes a deepening shadow, paralyzing to business and discouraging to personal efforts.

Always there has been a seeking for new sources of revenue and never concrete results in cutting down expenses. Unless derived from further development of State resources, a new source of revenue constitutes a burden either on persons or business and is sure to be passed to the ultimate consumer.

A constructive program for development of the State's resources and elimination of waste in energy and material will mark real progress. Eighty per cent. of the population and ninety per cent. of the taxable value of the State lie within five miles on either side of the Hudson River and the Barge Canal, between New York and Buffalo.

The hundred and fifty million dollars of our money invested in the canal lies practically idle, awaiting boats and freight handling facilities. Our ports, waterpowers and forests should be made to serve the people. The citizens of this State are entitled to a business-like conduct of their affairs and should demand nothing less.

Industrial Notes

The Humboldt Potash Co. will construct at Fallon, Nevada, a potash-recovery plant operating on deposits of a 36,000-acre tract controlled by it in Dixie Valley, Nevada. The first unit of the plant is expected to turn out muriate within four months.

* * *

What is said to be the only known deposit of pure water-soluble potash-alum occurs in commercial quantities about seven miles southeast of Blair Junction, on the Goldfield & Tonopah R. R., in Esmeralda county, Nevada. This deposit is owned and operated by the Western Chemicals, Inc., with headquarters in Tonopah, Nev.

The Western Chemicals, Inc., was organized and financed by Nevada mining engineers, chemists, bankers and professional men. The officers are: W. B. Roberts, president and general manager; H. H. Atkinson, vice-president; J. A. Roberts, treasurer; S. D. Pepin, secretary; J. Musgrove, Martin Chiatovich and L. E. Ruppe, directors.

* * *

The Nitrate Agencies Co., a subsidiary of W. R. Grace & Co. of New York, is building a \$250,000 plant at Bergen Point, Bayonne, N. J., for the manufacture of dyes, disinfectants, intermediates and spraying materials. The four-story building will be of hollow tile, reinforced-concrete construction, with 36,000 sq. ft. capacity. An additional warehouse of 20,000 sq. ft. floor space is also planned. The Elliott C. Brown Co. of New York has the contract for erecting the plant. Production and sales department will be in charge of Mr. Goulard. Dr. Joseph L. Turner is the technologist. The plant is expected to be in operation next September.

* * *

The Tower Mfg. Co., New York City, has acquired from the Marden, Orth & Hastings Corporation the chemical plant of the Marden, Orth & Hastings Co. and the Calco Chemical Co., at 87-105 Doremus avenue on the Passaic River at Newark, N. J. The property comprises about ten acres of land and twenty-two buildings and was held at \$750,000.

Development of the Laboratory in the Meat Packing Industry

By L. M. Tolman

Chief Chemist, Wilson & Co.

Here is set forth an aspect of the expansion of the merchandizing activities of the packer little emphasized, viz.: its origin in the work of the chemist. The expansion has been as natural as any process in biology which has efficiency for its unconscious aim. Acquiescence to public opinion that there may be too much of a good thing detracts not from the credit due the chemist. Many men can relate from personal experience the history of the chemists' work in the several plants at the Union Stock Yards in Chicago, and elsewhere. Chemists came and went and exemplified in their contact with a very practical type of business man that the value of the industrial laboratory is a direct reflection of the man in charge. In the early days it was a hard school; and in the fierce light that beat upon the laboratory were disclosed many men who are leaders today in the packing and allied arts.

Historical

Among the large food producing industries in this country, the meat packing plants were the first to develop a scientific and technical control. Very early in their history, laboratories were established primarily to control such by-products of the industry, as fertilizers, greases, tallow, etc., which were bought and sold by values determined in the laboratory.

It was, however, only a short time after the establishment of these laboratories, and the introduction of technically trained men into the industry, that we find an expansion from this analytical control over by-products to the development of research work, particularly along the lines of finding, for these by-products, more valuable uses than as ingredients for fertilizers. Especially is this true as regards the development of the pharmaceutical preparations, which were made largely from materials which were formerly of value only as waste or fertilizer.

The laboratories in their effort to develop each by-product into a more valuable finished product, have guided very largely the expansion which has taken place in this industry, and have been the cause of the packers entering so many different lines in order to utilize these numerous by-products. Glues, gelatines, soaps, glycerine, lard compound, cooking and edible salad oils, fatty acids, all kinds of tallow, greases, animal oils, neatfoot oils, cattle foods, fertilizers, roofing and insulating pitch, etc., are some of the common by-products. Then there is that whole list of pharmaceutical preparations which require the highest development of physiological chemistry in their manufacture, such as the pituitary and suprarenal extracts, pepsin, rennet, and many other similar extracts, and a long list of dried animal glands which are either sold to the large manufacturing druggists or manufactured into the finished medicinal preparations. It has been the work of the laboratory to develop the methods of manufacture for these products and to standardize their quality and purity.

The laboratories of the packing houses may in general be classified under three heads. First, chemical control; second, research; third, chemical engineering and manufacturing development.

The feature of scientific control has been developed to a high degree, therefore the first classification to be considered is control laboratories.

Control Laboratories

In the farm-curing of hams and bacon, the product is almost never of the same flavor and character, but in great packing plants, where many millions of dollars' worth of meat are constantly in process of curing, for these products to be of uniform quality and flavor, it is very essential to have exact control over the ingredients used in making up the curing solutions, such as saltpetre, sugar and salt; and to know that the composition of the finished pickle is uniform and that the meat as it is being cured is going to be of a uniform and standard quality; so one of the most important functions of the laboratory is supervision over the curing cellar.

The manufacture of oils and fats, both edible and inedible, require constant control. The desire of the manufacturer is to obtain as large a percentage of the highest grade product that is possible. The laboratory and the plant are constantly on the watch for any change in operation which will improve the quality. Slight imperfections in manufacture, which can be readily overcome, if neglected, may change an edible lard to an inedible grease of a much lower value. The same is true of edible oils, which are bought by any manufacturer making lard compounds and edible salad and cooking oils. These oils are largely bought in their crude, un-refined condition, to be refined at the various plants. The buyer of the oils is almost entirely dependent upon the laboratory examination of the oil purchased to determine, 1st whether or not he has received an oil of contract quality, and 2nd to inform him what kind of a finished oil, refined and deodorized, he may expect. It is necessary that a sample of each tank car of oil purchased be submitted to the laboratory for refining, bleaching, quality and quantity tests, to give the operating and sales departments the proper information as to what this oil is best suited. Further, after the oils have been received at the refinery, the laboratory must watch the refining process, examine the finished oil and the foots to determine whether the proper methods have been employed to obtain the best yields and the lowest amounts of loss.

Especially during the last few years has this line of laboratory control work been expanded, owing to the introduction of a considerable number of oils into the edible market, which had not been used to any great extent previously, such as



Fig. 1—General Laboratory, Wilson & Co.

corn oil, coconut oil and soya bean oil. Each of these types of oils had to be studied thoroughly as to proper methods of handling and refining and control over their behavior in the refinery.

In a large packing house the laboratory is required to maintain a control over the following manufacturing departments: Fertilizer, lard refinery, compound plant, butterine plant, tallow and oil refinery, glue, soap and glycerine plants. The object of this supervision is to keep the plants up to the highest degree of efficiency, and to watch for losses that might be due to improper operation or other causes.

In many cases these control laboratories are located in close proximity to the particular operations which they control. In other cases the control is carried on through a general laboratory to which samples are sent. Perhaps the most typical laboratory exercising direct control of the plant would be the laboratory in the butterine factory. Here is essential for the chemist to be in close touch with plant operation, and be able to make immediately examinations, and report results so as to keep the department heads informed. All of the oils and fats must be examined as to quality, purity and presence of coloring matter; the daily shipments of milk be tested for quality and composition; tests must be made of each batch of the manufactured product as to the amount of salt, moisture and curd; and this information must be in the hands of the operating department promptly that their future action may be determined.

The oleomargarine factory laboratory is equipped as would be that of a large creamery or butter factor, inasmuch the tests to be made are practically the same. This form of control affects standardization of the product in uniformity of composition, quality and flavor and of increase of its keeping qualities. Such a laboratory is devoted largely to routine work, but as the men are constantly in touch with operations they see many special problems which either may be worked out by men in this laboratory, or be made the subject of special investigation by the research department.

In general the control of other manufacturing lines is carried out, in as far as possible, by the establishment of small control laboratories throughout the plant. The routine analyses of the central control laboratories is largely directed toward

the examinations of sales samples of fertilizers, fats, tallow, greases, animal oils, etc., which are sold almost entirely on the basis of definite specifications, which specifications are dependent upon chemical analysis. These tests must be made with great accuracy, because of the very large amounts of money involved in each case. For instance, a tank car of tallow consisting of 60,000 pounds is sold on the basis of a certain amount of moisture, dirt and unsaponifiable matter, and the price is reduced or increased depending on this amount, so that it can readily be seen that a difference of one per cent on a shipment of this size means a very considerable amount of money, necessitating accurate control.



Fig. 2—Fertilizer Laboratory, Wilson & Co.

Supplies and Material Control

All large manufacturing plants have developed in recent years a control over supplies and materials purchased, such as paints, metals, cement, rubber hose, sugar and a thousand and one other articles entering into the operation of a large plant. This control has been developed to a very considerable extent but does not offer any special feature to distinguish it from the same type of control now common in all large manufacturing institutions.

Research Laboratories

Primarily the meat packing industry is a food-producing industry, and the most important research work to be done is along the lines of the improvement, development and utilization of the food products manufactured, so that under the head of research laboratories in the modern packing house, we will find a completely equipped bacteriological laboratory, domestic science laboratory, physiological laboratory, in addition to a general research laboratory, dealing with more general problems. The type of work carried out by these different laboratories is almost entirely on problems that come up in plant operation and most of the work, or a very large part of it, is carried out in the plant itself in studying the operations and trying to determine the cause of difficulties and methods for improving the products.

Bacteriological Laboratory

In recent years the value of the science of bacteriology in the study of the keeping qualities of

food products has been very greatly developed, and many of the important questions as regards the causes of spoilage and its prevention have been solved by bacteriological examinations.

The principal work of the bacteriological laboratory is devoted to the causes of contamination and the study of methods for increasing the keeping qualities of the products. As practically all cases of spoilage in handling is due, more or less, to the growth of bacteria, the very great importance of careful bacteriological studies in a food manufacturing plant is apparent. By this means one is able to trace back to its source many of the causes of spoilage. This spoilage trouble creeps in at every stage from the handling of the raw materials to the finished product. It may be in the methods of handling the raw materials, methods of manufacturing, or conditions of storage and distribution.

Bacteriological tests give us the greatest amount of information as to the causes of our difficulties, and often show that the cure is a matter of very little cost. As an illustration of how bacteriological methods are applicable in studying spoilage questions, I will review briefly an investigation of a gelatine plant that was having considerable difficulty as to the quality of the finished product owing to its very large content of bacteria. An investigation of the plant was made and a series of samples taken through each stage of the operation from the raw material, through the cooking and storage vats and into the drying rooms. A bacterial count indicated that at one particular stage of the opera-

to contamination from unsterilized utensils, and which in most occasions can be overcome by the simplest precautions.

Many of the curing processes of the packing house are more or less fermentations and so subject to accurate control. Undoubtedly the future will see the development of this type of factory control not only in a meat packing house but in all other food establishments.

Domestic Science

Recent developments have made necessary a well-equipped domestic science laboratory, and workers trained along these lines to develop the uses of many of the products, so that when they are put on the market they may be sold to the customer to whom they will give the best results.

This utilization of scientific methods of cooking has of late years been very greatly appreciated. A large manufacturer expecting continuously to do business in certain lines of food products can not make a permanent success unless the products are satisfactory to the user, and it is possible so to instruct the user in the methods of proper handling. Such a laboratory should be equipped with electric baking ovens, drying ovens, etc., which can be carefully controlled so that experiments can be carried out in a carefully controlled manner.

Chemical Engineering and Manufacturing Development

In the last few years there has been a strong development along the lines of chemical engineering and improvement of manufacturing methods, and no large packing house is properly equipped without an industrial research laboratory, equipped so as to permit investigations of processes to be carried out on a semi-manufacturing scale. So that in most large packing houses we find throughout the plant, or collected into an industrial laboratory, small sized equipment generally of the same type as that used in the plant, but of sufficient small size to enable accurate tests to be made on a few hundred pounds of material, which will determine the proper yields, or to try out new methods of handling.

Application and Uses of the Laboratory

The work of the laboratory has application to almost every activity of the plant; to the operating department as a control and efficiency aid, to the sales department in supplying them with informa-



Fig. 3—Bacteriological Laboratory, Wilson & Co.

tion there was a large development of bacteria. This development took place between the storage vat and the drying frames. Additional samples taken showed that the contamination occurred at one point where a small amount of gelatine was allowed to remain four or five hours between batches in a warm condition which rapidly developed bacteria and underwent decomposition which contaminated the batch following. By simply washing out with hot water after each batch, this amount of gelatine was removed and the entire difficulties of operation overcome. This illustration shows how simple many times it is to discover a difficulty which is causing a great deal of trouble by the application of simple bacteriological methods.

In the handling of milk it has also been found that bacteriological methods are of great value in eliminating spoilage, which is almost always due



Fig. 4—Domestic Science Laboratory, Wilson & Co.

tion as to quality, uses and values of the products which they have for sale; to the purchasing department in advising as to the character of materials received; and to the advertising department in giving advice and information regarding the character and quality of the products they have to deal with. As a matter of fact the laboratory acts more or less as a clearing house of information to the various parts of the plant and to the various divisions

Future Developments

The possibilities of development of new products from the by-products of the packing house seem almost limitless, especially in the field of medicine. Apparent as yet only the surface of the problem has been scratched, either as to number of substances to be produced or to the best methods of production or standardization of those we already make.

Conservation of Our Natural Gas

By Dr. J. B. Gardner,

Director of Research, Hope Natural Gas Co.

A period of more than thirty years has been required for the development of the natural gas industry. The early years saw almost incredible waste. Natural gas was a new product to civilization. Uses and markets were not numerous and the supply appeared to be inexhaustible. The largest wells were found, for the most part, in isolated or thinly populated regions. Markets had to be created at long distances from source of supply, uses had to be discovered and large and expensive transmission systems had to be installed.

The uses of the product domestically and industrially soon demonstrated its great value. The demand for natural gas rapidly increased. Larger and larger investments were required, competitive companies were organized after it had been demonstrated by the stronger, pioneering companies that the product was one of great commercial importance. Competitive endeavors to get from offsetting wells the largest possible production of gas, competitive attempts to enlarge markets even at ridiculously low rates, inefficient methods of drilling, more or less indefinite procedure in the construction of transportation lines, little or no attention to distributing systems, and practically no regard for the efficiency of the devices for utilizing natural gas as a fuel, all of these factors contributed to the wasteful depletion of the natural gas supply.

The hazard of the industry rapidly increased, new fields had to be sought, more efficient methods of drilling, transporting, distributing, and consuming natural gas were necessitated. In recent years, the demand for this finest of all domestic fuels has so rapidly increased that the product has become one of our great national commodities. The available supply has so rapidly decreased that a public sentiment has spontaneously developed demanding that the remaining available supply be conserved.

The movement for natural gas conservation is nation-wide, demanding that economy of utilization in the future displace prodigality of waste in the past. Public spirited movements, prompted by the belief that that which contributes most to the welfare and happiness of the domestic consumer is the highest form of conservation, have been inaugurated with State Utility Commissions for an increase in rates. This is one of the few well-directed steps looking to the conservation of our supply. A review of the variation in cost to the consumer of all other commodities discloses the fact that the advances in other commodities have been far out of proportion to the increase in cost to the consumer of this almost indispensable product. The conditions of the times and the movement toward conservation certainly justify material increases in rates.

State or Federal regulation of all matters pertain-

ing to production, transportation and distribution, whereby a pooling of interests is legalized and effected, will extend the life of gas fields and minimize the cost of gas to the consumer. Legislation affecting natural gas production, transportation and distribution can either be so regulated as to conserve our supply and safeguard the existing investments in a hazardous business, or it can be made confiscatory and contribute nothing to the progress of the industry or to life of the supply. The magnitude of the industry, the excessive demand for gas, the high value placed upon gas-producing lands and the industrial uplift which has come about in natural gas-producing regions formerly isolated or of little importance commercially, are all the direct outcome of the far-sightedness of the men who had faith in the possibilities of natural gas.

Capital should have its fair return from the investment required but the general public, the main beneficiary, has forgotten its debt of gratitude or that it owes any obligation, moral or otherwise, to capital which has made the industry what it is. The general public has been chiefly interested in securing a wonderful, clean fuel at ridiculously low cost. If the public is to continue to be benefited, the natural gas industry must have its closest co-operation in all things looking toward the prolongation of the life of the supply. Otherwise, the public "pays the freight" and the utility suffers. Ten or fifteen years ago, far seeing men connected with the industry saw that methods of conservation and higher forms of utilization of natural gas must come.

The natural gas gasoline industry is an outgrowth of their vision. Ten years ago no one would have risked injury to a transportation and distribution system of natural gas by the installation of a gasoline plant on its lines. A suggestion that such an installation be made would have been flatly turned down by the manager of a natural gas-producing and distributing company. It had never been tried and the outcome of such an undertaking was not apparent. The history of the natural gas industry proves the correctness of this statement. It was only after repeated trials, extensive experimentation and the investment of large sums of money that the feasibility of the proposition was realized. The success of the natural gas gasoline industry has been established. The product which was formerly wasted because it was of no value to either the gas consumer or the gas producer is now saved and utilized. The growth and development of the natural gas gasoline industry has been one factor which has awakened the entire industry to the possibilities of gas. Today, the whole natural gas industry is responsive to any proposition which has for its purpose a higher form of utilization by any means whatsoever.

Transport of Chemicals By Ship

British Board of Trade Provisions for Sea Shipment of Chemicals.

Sulphuric Acid, Oleum or Nordhausen

The question having arisen as to the conditions under which strong sulphuric acid contained in electrically welded steel drums, or welded by other approved methods, holding about half a ton each, could, with proper regard to safety, be carried on board ship and stowed under deck, two steel drums of the following dimensions were tested to destruction:

External Diameter.	Length Over all.	Thickness of Body.	Thickness of Ends.	Approximate Weight of Drum and Sulphuric Acid.	Remarks.
Ft. In.	Ft. In.	In.	In.	Lb.	
2 1 1/2	2 2 3/4	0.07	0.08	410	Ends unstayed.
		0.09	0.087	1,420	Ends unstayed; body strengthened near the centre part by two 1-shaped rolling rings, 1 1/2 inches deep.

The ends were flat and flanged at the periphery and electrically welded to the body. The results showed that they are strong enough to withstand rough usage when filled with sulphuric acid.

The acid can be carried with safety under deck if a layer of slack coal not less than one foot in depth is laid at the bottom of the hold and carefully levelled off. Then a tier of drums should be stowed upon it, and when the first tier is completed additional coal should be added and levelled off. Slack, breeze, or such trade types of coal can be used for this purpose. A further tier of drums can then be laid, and the process of filling in with the small coal again resorted to, and so on to a height of as many as four tiers.

In the event of leakage, coal even in a powdered state will not evolve heat by reason of the presence of sulphuric acid, and the marketable condition of only so much of the coal as is wetted by the sulphuric acid is affected.

The possible results that may be anticipated as regards spontaneous combustion in a cargo of coal on the surface of which drums of sulphuric acid have been embedded are:

(1) If the sulphuric acid escapes into the coal spontaneous combustion will not take place within the region of the leakage.

(2) If the spontaneous combustion takes place first, then the rupture of the drums and consequent escape of the sulphuric acid will retard or extinguish the fire by the production of sulphurous acid vapor, in which combustion cannot be sustained. This gas has a pungent odor and a strongly suffocating effect, so that great care should be taken to keep away from it.

Any coal that has been wetted with sulphuric acid should not afterwards be used.

It is the practice at some ports to stow sulphuric acid in a compartment by itself on a layer of chalk, but the leakage of sulphuric acid on to the chalk would produce carbonic acid gas, a heavy odorless gas which it is dangerous to inhale, and which gives no warning of its presence. For these reasons the ventilation of a space where this practice is followed

should be carefully attended to before any person is allowed to enter the compartment, the down cast being carried as low as possible.

It is recommended that wherever sulphuric acid is carried under deck, the precautions indicated above should be observed; but it is, of course, to be understood that drums of sulphuric acid should not be stowed on coal known to be specially liable to spontaneous combustion.

If sulphuric acid is carried as deck cargo, the drums containing the acid should be stowed as to be safe and secure, and readily jettisoned in case of danger, and so that neither the stability of the ship nor the free communication of the crew on the deck is dangerously interfered with.

Sulphur Dioxide

Sulphur dioxide is neither combustible nor explosive, is not corrosive in the sense in which aquafortis and oil of vitriol are, and is not "Dangerous Goods" within the meaning of section 446 of the Merchant Shipping Act, 1894. It is a heavy suffocating gas at ordinary temperatures and under atmospheric pressure, but is a liquid at ordinary temperatures if kept in vessels under a pressure of about three atmospheres. The latter state is its usual condition when stored in glass syphons or in metal cylinders. If the vessels burst or the gas leaks, gaseous sulphur dioxide is discharged into the air, and in confined spaces this is dangerous. The pressure of liquid sulphur dioxide rises rapidly with increasing temperature, and for this reason vessels containing it should not be carried if more than seven-eighths filled. Syphons and cylinders containing sulphur dioxide must be kept in a cool place, away from boilers, and protected from the direct action of the sun's rays. The cylinders used for transporting this substance may be of wrought iron instead of steel.

It may not be carried on emigrant or passenger steamers without special permission from the Board of Trade. On cargo vessels the carriage of syphons should be confined to deck cargo, and the syphons should be packed in a case and embedded in powdered chalk. Metal cylinders should be enclosed in stout rope mat or in wooden cases to prevent concussion, and should be kept cool and away from the living quarters; they should be readily accessible, but may be stowed either on deck or under deck.

Hydrofluoric Acid

This acid may be carried on board cargo vessels or passenger vessels other than emigrant ships, with special stowage and apart from foodstuffs, if put up in thoroughly strong leaden bottles containing not more than 80 pounds of the acid, securely closed, luted, and tied over, carefully packed with straw in wooden cases, and distinctly marked "Hydrofluoric Acid—Dangerous."

Pyridine

Pyridine should be marked for shipment as dangerous goods unless a certificate is furnished that its flashpoint is over 73° F. Pyridine with a flashpoint of over 73° F. may be stowed under deck, provided it is contained in strong steel drums

and stowed adjacent to the hatchway of a compartment in which no explosives are stowed.

Sodium Chlorate

Sodium chlorate should be carried on board ship under the same conditions as those laid down for chlorate of potash, which are as follows:

(1) The chlorate should be packed in iron drums, or, if that is not possible, in paper-lined casks of sufficient strength not to allow any of their contents to escape when subjected to rough usage.

(2) Casks or drums containing the chlorate should not be stowed in the same hold with combustible materials, or should be separated from such substances by a partition.

(3) They should not be stowed in the neighborhood of the strong mineral acids, especially sulphuric acid, in such a manner that any escaping acid could reach the chlorate.

(4) Not more than ten tons of chlorate of potash should be carried in one hold.

Perchlorate of Potash

This substance may be carried under deck on board ship provided it is not stowed in any compartment in which is T.N.T. or other material of that nature, and that it is packed in suitably lined cases or casks.

Amorphous Phosphorus and Sulphides of Phosphorus

Amorphous, or red, or Schrotter's phosphorus, which is wholly distinct in its physical characteristics from ordinary or yellow phosphorus, is not liable to spontaneous combustion, and does not take fire in air until it is heated to 260°C. or 500° F.

This, although a low temperature as compared with most other substances, is, nevertheless, considerably above the temperature of the ignition of dynamite or similar explosives as well as that of most varieties of matches. It is a temperature which on board ship would not be reached except through fire.

No objection need be taken to its stowage below deck, provided it is packed in tin.

It may be added that shipments are usually made in 10-pound tins, ten tins being stowed in a case, and that it is not necessary to preserve this phosphorus under water. The precautions taken with regard to the shipment below deck of amorphous phosphorus will be quite suitable in the case of sesquisulphide of phosphorus or scarlet phosphorus and pentasulphide of phosphorus, and no danger connected with the carriage of either of these two substances need be anticipated, provided the compound is packed in airtight tin vessels.

The sulphides of phosphorus slowly evolve sulphuretted hydrogen, and, on this account, the vessels containing them should be closed efficiently, and the package should be readily accessible for removal in case of need.

Sulphides of Potassium and Sodium

The sulphides of sodium and potassium in the dry or anhydrous form are liable to spontaneous combustion, and should be packed in strong, airtight vessels, such as steel drums. When so packed they may be stowed below deck even in a vessel carrying explosives.

In the hydrated condition the sulphides of sodium and potassium are not liable to spontaneous combustion, and no objection need be raised by an

officer of the Board of Trade to their shipment on this account.

If not fully hydrated, i. e., containing at least 50 per cent. of water, these substances may be carried on board ship without special restrictions, provided they have been manufactured in such a way as to make the presence of free sulphur practically impossible, and provided they are packed, either fused or in cakes, but not broken up, in strongly made hermetically sealed iron drums, in which special precautions have been taken to leave as little air space as possible.

All sulphides of sodium or potassium should be stowed so that they may not come in contact with acid.

Peroxide of Sodium

Peroxide of sodium by itself is not an explosive, but it becomes dangerous when it comes into contact with any combustible substance; it should therefore be packed in iron or steel drums sufficiently strong or stand rough usage without allowing any of their contents to escape, and not too large for readily handling. The drums should not be stowed in a space containing combustible materials.

Peroxide of sodium may be accepted for stowage in the shelter deck of vessels if packed in 14-pound tins, eight of those in a tin-lined case, and that enclosed in a strong outer case, and stowed apart from combustible material.

Caustic Soda

Caustic soda, if carried below deck in any foreign-going ship, must be packed and stowed under the same conditions as caustic potash, which, when packed in iron or steel drums, may be carried with safety below deck, provided the drums are so placed that no leakage from them can come into direct contact with crew or passengers.

If loosely packed in strong oak casks which are watertight caustic may be allowed, so far as the Board of Trade are concerned, to be carried under deck in coasting or home-trade vessels, and as deck cargo in any ship.

Aniline Salt

This substance is toxic, and should not be stowed near food. It should be so stowed that it cannot come into contact with alkalis, as might possibly happen in a ship carrying general cargo. Provided the salt is dry, its carriage in packages lined with wood, paper, tinned iron or foil, is not open to objection.

Peroxide of Hydrogen

Solutions of peroxide of hydrogen, guaranteed not more than 6 per cent., are allowed to be carried in any ship. Higher percentages are not allowed in emigrant ships or in ships carrying explosives.

Barium Peroxide

Barium peroxide by itself is perfectly safe at all temperatures likely to be met with in the ordinary holds of a ship provided it is packed in strong iron or steel drums, hermetically sealed, to prevent either the escape of the powder from the container or the entry into the container of liquids or gases. It should not, however, be stowed against an engine or boiler room or bulkhead.

The drums may be carried below deck, provided they are properly stowed and efficiently chocked off.

It is also necessary, owing to the oxidizing character of barium peroxide, to segregate it as far as

possible from inflammable matter with which it might become mixed or against which it could be rubbed if it should escape from its packages.

The stowage of barium peroxide should be arranged in such a way as to avoid all risk of ignition from electrical short-circuit fuses, or other sparks.

The use of sulphur dioxide or chlorine gases must be avoided where packages of barium peroxide are present.

Barium peroxide, if carried in wooden casks, must be stowed only on deck.

Chromolyte Powder

This substance should be packed in lead tubes contained in lead or tin-lined receptacles. The use of sawdust and other organic substances for packing receptacles containing a material of the nature of chromic acid is undesirable and sand or earthy matter should be employed for the purpose.

Granulated Aluminum

There is no special danger connected with the carriage of this substance, provided it is kept apart from mineral acids.

These substances are in themselves safe to handle and store, but that in contact with certain acids, such as strong hydrochloric acids, they may take fire. Both the metal and the powder are easily

ignited by a flame, and when alight they are very dangerous substances. These goods should, therefore, be packed so that there is no danger of their taking fire or coming into contact with strong mineral acids. The usual method of packing them is in strong tin-lined cases, and this may be considered as satisfactory.

Chlorine

When cylinders of chlorine gas are carried on board ship, they should not exceed 8 inches in diameter or 5 feet 6 inches in length, or weigh, as stowed, more than 2 cwt. each, and they should be protected by coil rope matting, or other equally effective protection, and not stowed near consignments of sodium, potassium, phosphorus, copper leaf, powdered antimony, turpentine, ammonia, or sal ammoniac. If larger cylinders are necessary for military purposes, they should be specially protected.

Corrosive Sublimate

Corrosive sublimate in small quantities is usually packed in bottles in cases, but, in large quantities, it is carried in strong casks, such as wine or beer casks. This type of cask is necessary to prevent the fine powder sifting out and possibly mixing with foodstuffs.

Erection and Use of Chemical Stoneware Apparatus

Principles

In the use of chemical stoneware it is necessary to remember always the following facts:*

(1) Stoneware is a fragile material whose resistance to tension and flexure is limited, while its resistance to compression is considerable.

(2) Stoneware withstands sudden changes in temperature very poorly.

(3) This ability to undergo temperature changes improves with diminution in thickness of the apparatus and with the regularity of the heating.

Precautions

From the above principles are derived all the precautions that must be taken to obtain from the use of chemical stoneware all the advantages characteristic of it and which are due to its flexibility, resistance to corrosive action and to the ease with which it lends itself to the manufacture of apparatus of all shapes and an infinite variety of dimensions.

In what follows, there will be discussed the various practical applications of the above principles.

Erection of Earthenware Piping Systems

Earthenware piping systems should always be firmly supported on rigid supports. Every deformation of the supporting framework results in a corresponding displacement of the piping system, and, as the elasticity of the stoneware is a minimum, the rupture of the apparatus is a natural result.

This does not mean that the rigidity of the supports should involve absolute rigidity as well in



Fig. 1—Support of Piping for Muffle Furnace

the connections between the stoneware and the supports. Quite the contrary, it is very necessary that the connection be able to yield without difficulty to movements due to expansion brought about by changes in temperature and deformations, caused by tightening up the joints.

Figure 1 shows the method used to support piping for a muffle furnace. Very large pipes (300 to 400 mm. in diameter) are best supported in their entire length in a sort of cradle, made from parallel boards placed edgewise, but allowing the pipes free play. It is also well to provide that the liquors coming from the leaks, caused by defective joints, should not flow down the supporting framework and cause thereby its rapid deterioration.

Treatment of Wooden Props

The wooden props should be painted or covered with pitch, as they are susceptible to warping, due to the humidity of the air. Supports, made of metal, are often advantageous, although their cost is higher. They wear well, if the precaution is taken of tarring them or painting them at regular intervals.

Slope of Piping Systems

It is necessary, wherever possible, to place the piping at such a slope that the liquids, which circulate through it or which arise from the condensation of vapors, cannot remain in the pipes.

*Abstracted by Ismar Ginsberg, Aetna Explosives Co., from *Chémic et Industrie*, Vol. 2, 809-813.

The entrapment of liquids below joints is one of the principal causes of their deterioration. Appropriate cleaning traps, provided with discharge taps or siphons, should be placed at the low spots in the line.

Joints—Play in Joints

In a jointed piping system, the joints should always be arranged in such a manner that the flange of the pipe always points upward, that is to say, forming a basin and not a bell-like cover. In piping systems of extreme length it is necessary to provide for the replacement of a single link in the system, without being obliged to move the whole apparatus. The pipes should not be thrust as far as they can go into the collars, but it is advantageous to allow a certain amount of play, which would permit the resetting of an intermediate piece of piping, without being obliged to take down and set up again a large number of successive joints. Conical piping (see Figure 2) is particularly suited to this kind of a remounting process.

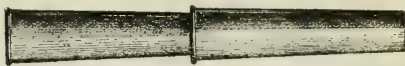


Fig. 2—Jointing Conical Pipe

Flanged Joints and Joints Provided with Conical Threads

On the contrary, in piping systems, in which flanged joints or joints fitted with threads are used, which piping is used more especially for the transportation of liquids, no play can exist at the junction. It is consequently necessary, when setting up a straight length of pipe of considerable size, as is the case, for example, of the return-flow pipe of a pump or an acid lift, to provide at certain intervals expansion joints (see Figure 3), which easily permit the removal of a section of the piping.

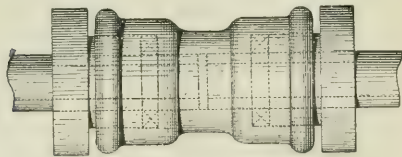


Fig. 3—Expansion Joint

Vibrations

Certain very particular precautions must be taken when the piping is subjected to vibrations, as in the case of the return-flow pipe of an acid lift. The supporting framework must possess, in that case, the greatest rigidity, without which the joints would rapidly deteriorate.

The bends should be as obtuse angled as possible. It is well to design the sections in such a manner as to allow liberally for the stresses to be withstood, as the smaller the resistance of the piping, the less the fatigue of the joints will be. In general, it is well to place the piping under the ground, permitting easy access to the joints for repairing purposes.

Gutters

When it is necessary to place pipe under ground they should be laid in gutters, the covers of which are easily removed. Supports or brackets must be used and care taken to place them at a sufficient

distance from the walls so that repairs can be made to the joints without any great difficulty. (See Figure 4.)

Draining Wells

Draining wells or sumps should be placed at the low places to collect the liquors lost by leakage as well as for the emptying of the piping system in the event of repairs. A slight slope, which allows a complete emptying of the gutters, is always useful.

Iron Supports

Each pipe should be separately supported. If the support is made of iron, it is well to interpose

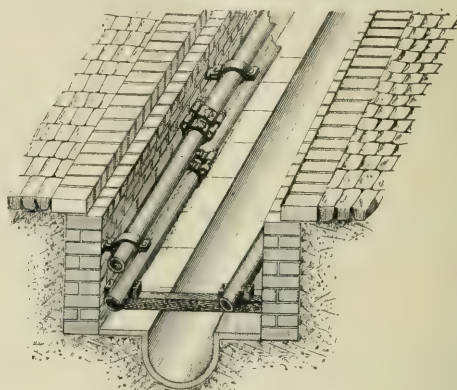


Fig. 4—Arrangement of Underground Piping System

a plastic material (tarred tow or pieces of rubber tubes), which gives the connection flexibility.

Setting Up the Apparatus

When a piping system is put together, it is necessary first to place the pipes together without making any connections, and to make sure that the pipes are properly aligned both as to length and direction. Then the supporting framework is adjusted and the fitting together of the pipes is commenced at one end by making the joints but without screwing down the bolts tightly. Only when everything is in place and the joints are all properly set up is the fastening of the bolts completed. This is always done very gradually, starting as before at one end. To avoid tightening the bolts with too much force, wrenches with short handles are always used. Before putting the apparatus together, it is necessary to make sure that the bolts themselves are easily screwed into the holes by hand.

In piping systems provided with plate flanges, the tightening of the bolts holding together the double flange plates should proceed as carefully as possible. As the joint is being made, the breaking force exerted by the bolts at the end of a long lever arm is at a maximum, that is to say, it is exerted at a point of least resistance, and this is so in spite of the great thickness and strength that are purposely given to these parts of the apparatus.

Figure 5 shows the different methods of fastening together piping systems.

The same precautions as described above apply

to the tubes and pipes of any apparatus when joints are made.

Rings or Round Plates

It sometimes happens that it is necessary to bring together pipes, one after the other, whose flanges are not absolutely parallel, or it is sometimes necessary to fit into a line a piece of piping that is not of the exact length required to make the desired connection. In this case, use is made of rings, cut flat or on a bias (see Figure 6). It is always

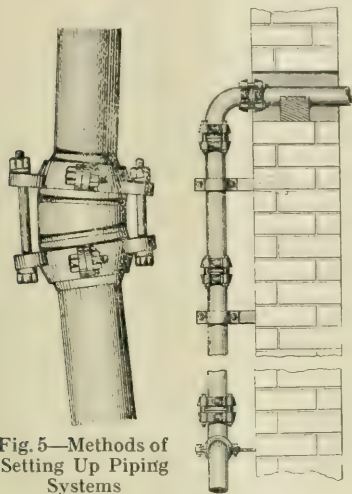


Fig. 5—Methods of Setting Up Piping Systems

advantageous to order these rings at the same time that the piping is ordered, and to see that they are provided in different lengths and cuts. Special double flanges are not necessary, as the rings may be inserted very simply in the joints. The length of the bolts is all that changes. When it is required to connect various pieces of apparatus by means of pipes, it must always be seen that the connections are of such an order that a slight variation in the length of the pieces does not give rise to any great difficulty or even the impossibility of putting the apparatus together.

Setting Up Connections

In the apparatus shown in Figure 7, which represents a battery of Valentine condensers, the various parts, a, b, c and d are of fixed lengths. If these lengths do not correspond to the lengths of the pipes, a slight displacement of the jars will, nevertheless, make the connection possible, but if

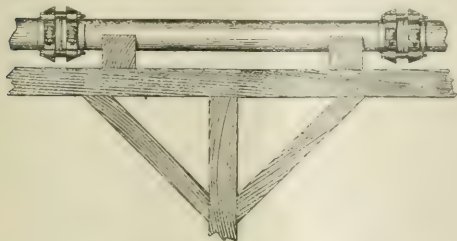


Fig. 6—Showing Pipe Connections and Support

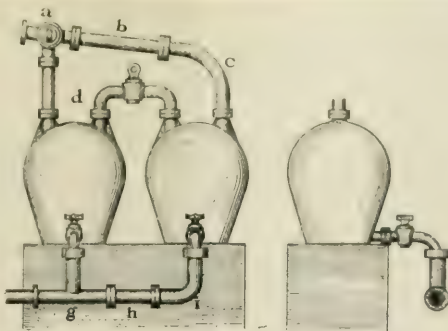


Fig. 7—Connecting Plate-flanged Pipe

there is a third connection, made up, for example, of a rigid system of drainage pipes, g, h and i, the setting up of the apparatus becomes extremely difficult, if not altogether impossible. In this case the nature of this last connection must be such as to be sufficiently elastic to permit the connection to be made.

Connection by Siphons

A second example is furnished by the joining of large jars by means of siphons (see Figure 8). To insure the making of this connection, even in the case where the displacement of the pipes does not correspond exactly to the distance between the branches of the siphon, there is interposed an intermediate flange, placed eccentrically in relation to the piping of the jars. It is seen that the rotation of the flange on its axis will permit a variation in the deviation between the pipe lengths and the distance between the jars by a distance equal to twice the eccentricity of the flange.

Connections Between Acid Lift Parts Rigidly Placed

Finally, we will mention the connection of two tubes a and b of an acid lift with two tubes c and e of a rigid upright pipe. As it is practically impossible to make the two distances d and d' absolutely equal, there are inserted between b and e a straight piece of pipe, and between a and c a piece bent slightly in the shape of an S. This is of such a nature that on turning the two connect-

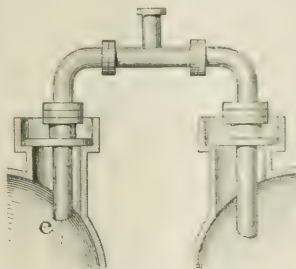


Fig. 8—Siphon Connection

ing pieces around the tubes a and b, it is absolutely certain to find a position in which the connection is possible (see Figure 9).

These three examples are sufficient to indicate

the kind of precautions to take to avoid the difficulties which can crop up in the course of erecting connecting piping systems. It is naturally neces-

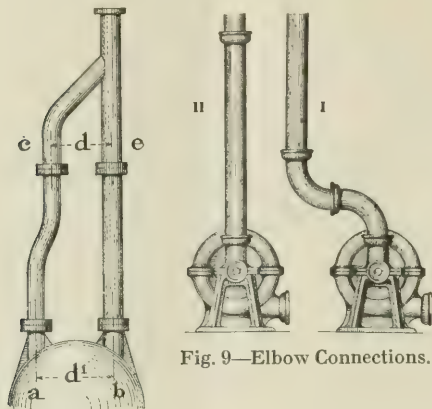


Fig. 9—Elbow Connections.

sary to diminish the number of joints as much as possible and to avoid the misuse of intercalary rings.

Connections with Important Apparatus— Use of Elbows

When the question arises as to the method of connecting by means of tubes an important piece of apparatus, such as a fan or a large jar, it is best to use an elbow instead of a straight piece of pipe. Thus, the arrangement I (see Figure 9), which would allow easy repairing in case of damage, is preferable to the arrangement II, which would necessitate much more labor in taking down the apparatus for repairs.

It is necessary to avoid as much as possible long straight lines of pipes. Elbows or changes in direction give elasticity to the system. If it is not possible to make use of elbows, expansion joints must be provided.

Long lines of pipes, only slightly inclined, may have air pockets at the high places. To remedy this condition, there must be placed from point to point vertical air vents to permit the air to escape.

The Gas Industry and the Petroleum Shortage

By Oscar H. Fogg,

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Historical

Early in the seventeenth century, Van Helmont, a Dutch chemist, in the course of some experiments with fuels, discovered that coal yielded up "a wild spirit," of a form so phantomlike and elusive that he named it "geist" (the German word for ghost or spirit) and so, in the very christening, gas was enshrouded in a veil of mystery that for many years was to obscure it and carry the suggestion of intangibility to the superficial mind.

The later experiments (1660-1670) of Dr. Clayton, a Yorkshire minister with a predilection for the sciences, robbed the spirit of some of its elusive qualities and brought it within the realm of practical things, for the clergyman demonstrated that bituminous coal "subjected to a red heat in closed vessels afforded a great deal of an air similar to the fire damp of mines but which burned with a brighter flame."

No application of these discoveries to practical use was seriously undertaken until late in the eighteenth century, when Wm. Murdock devoted himself to the task of producing gas from coal on a scale that would make possible its use for lighting. By distilling coal in an iron retort and conducting the gas through tinned iron and copper tubes, Murdock, in 1792, succeeded in lighting his house at Redruth, in Cornwall, and by 1798 he had progressed so far that gas illuminated one of the Boulton and Watt's shops at Soho, near Birmingham. On the occasion of the celebration of the Peace of Amiens, in 1802, a public display of the new light was made and "the illumination of Soho works on this occasion was one of extraordinary splendor. The whole front of that extensive range of buildings was ornamented with a great variety of devices that admirably displayed many of the forms of which gas light was susceptible." Two years later (1804) the entire establishment of Boulton and Watt was illuminated by gas.

During this period of Murdock's labors, Lebon, in France, and others elsewhere, were actively engaged in the effort to harness the spirit of the coal. The names of Van Helmont, Clayton, Murdock, Lebon, Clegg and Winsor are those of the pioneers of what was to become one of the foremost industries of the world, but Murdock's achievements along lines so essentially practical gave him the place now universally accorded to him as the father of the gas industry.

Under the stimulus of Murdock's accomplishments and the impetus given by Winsor to the commercial possibilities of the new illuminant, the art of gas manufacture took definite form. Winsor was the first to advocate publicly the distribution of gas from a central source and projected a company to manufacture and dispense coal gas for "enlightening the inhabitants of London," and for other purposes so extravagantly stated that much opposition was aroused to the scheme. His plan was in part accomplished by the foundation of the London and Westminster Chartered Gas Light and Coke Company, to which a Royal Charter was granted in April, 1812, and the following year the City of London Gas Light Company was established and the organization of others was undertaken.

Introduction of Gas Lighting

The first gas company in the United States was founded at Baltimore, Md., June 17, 1816, by the passage of an ordinance which permitted Rembrandt Peale and others to manufacture gas, to lay pipes in the streets and to contract with the city for street lighting. Other American cities were prompt to follow: New York in 1823; Boston, 1828; Louisville, 1832; New Orleans, 1833; Philadelphia, 1836; Cincinnati, 1840; St. Louis, 1846. The new industry had to make its way against popular prejudice and to overcome the difficulties of securing the necessary capital; but with these obstacles surmounted, its growth and

expansion proceeded as improvements in the art were made and as the centers of the country's population developed.

From the first the barriers of ridicule and prejudice had to be broken down. Napoleon had dismissed the idea of gas as, "Une grande folie," and Sir Walter Scott wrote to a friend: "There is a madman proposing to light London with—what do you think? Why, with smoke!"

In our own country, thirty years later, on November 28, 1833, several hundred worthy citizens of Philadelphia addressed a petition to "The Honorable, the Select and Common Councils" of that city condemning a plan to establish a gas lighting system.

Any statement of the early development of the gas industry in the United States owes acknowledgment to one of our own countrymen. David Melville, of Newport, R. I., lighted his premises in 1806 by means of coal gas which he had manufactured in apparatus of his own devising, which was necessarily crude, but was subsequently improved and patented by him in 1813.

For some years following its introduction gas served only as an illuminant. There had been early realization of its possible application to other uses, as evidenced in the early announcements of Winsor. Josiah Pemberton is said to have been the first to construct a gas stove, which was to be used for the purpose of soldering, in his button factory at Birmingham. A magazine description of 1825 gives us our earliest knowledge of the gas stove for cooking purposes as "a piece of gas apparatus for cooking by enclosing the circle of gas flames with its reflecting cone in a cylinder of tin, from the top of which a pipe takes off the burnt air." The writer adds "a hot plate has been heated by the gas and it has also been employed to heat an oven."

The practicability of gas cooking was demonstrated by James Sharp, of Northampton, England, about 1830 and following this, inventions for cooking by gas increased, although the popularity of the gas range was of gradual growth. The earlier gas stoves manufactured in the United States were not such as to lead to a very general use of gas for cooking purposes and not until after 1880 had the principles of design and construction reached a point which promised the production of the efficient and economical appliances which are today so universally used.

Modern gas manufacture follows, in the coal gas process, the original lines laid down by Murdock. About 1850 clay retorts began to replace those of iron and progress thenceforth was in the direction of greater efficiency of carbonization, more economical methods of heating the retorts and general improvement in the materials used and in the construction and arrangement of plant and equipment, as mechanical processes were developed and labor saving methods devised.

Water Gas Process

The first radical departure from the principle of gas manufacture disclosed by Murdock, at least the first to receive widespread recognition, was the introduction of the water gas process. Du Motay, a Frenchman, and T. S. C. Lowe were experimenting simultaneously in America, although independently of each other, along lines which were to result in a practical process for the manufacture of gas from anthracite coal, steam and oil. In 1781 Fontana had called attention to the reaction which takes place between steam and incandescent carbon at high temperatures—the basis of the theory and chemistry of water gas as it is known today. Ibbetson appears to have applied

Fontana's observations to practical gas making, when in 1834, in England, he made a water gas by passing steam through a mass of incandescent carbon.

In the thirty-five years following this, some sixty or more patents were taken out, including in one way or another this reaction of steam and carbon at high temperatures, but it is to Lowe that the water gas process in general use today owes its origin. Although the apparatus devised by him was subsequently greatly modified and much improved by others, it is still known by his name. In this apparatus was first employed the principles of the internal heating of the vessels required for the manufacture of the oil gas and the carbureted water gas, by the combustion in them of the combustible portion of the producer gas formed while the fuel in the water gas generator is being brought up to the temperature necessary for the decomposition of the steam. Lowe had served in the War of the Rebellion as chief aeronaut of the Army of the Potomac, where he was engaged in the manufacture of gas for balloons. In 1872 he took out patents covering some of the features of his process, and these were followed by patents in 1875 which are the basis of the present water gas process known under his name. The first Lowe apparatus was erected at Phoenixville, Pa., in 1873 and by 1880 the practicability of water gas manufacture had been clearly demonstrated and ten years later it was coming into very general use.

Water Gas Manufacture

The apparatus employed in the manufacture of water gas consists of three suitably connected, cylindrical vessels, constructed of steel plates and lined with a corresponding cylindrical wall of fire clay. The first of these vessels is called the generator, in which is contained the fuel (anthracite coal or coke) and in which vessel both the producer gas and the water gas are made. The other two vessels are called respectively, the carbureter and superheater and are filled with fire brick placed in rows, those in one tier being at right angles to those in the tiers next above and below, and so arranged as to leave openings for the passage of the gas.

Connections are provided for the introduction of the air blast, steam, and oil, and at the top of the superheater is a stack or outlet from which the producer gases from the generator, after passing through the carbureter and superheater and heating the first brick contained therein, are discharged into the atmosphere during the "blowing" or heating period. The deep fuel bed in the generator is fired under forced draft and the air passing through the hot fuel forms producer gas, the combustion of which, in the carbureter and superheater, heats the checker brick in these vessels to the temperatures required for the gasification of the oil. When the desired temperatures have been reached the air blast is shut off and the opening at the superheater stack is closed. Steam is admitted to the generator and passing through the fire is decomposed by the combination of its oxygen with the heated carbon.

The water gas thus formed consists principally of carbon monoxide and hydrogen; on leaving the generator it passes into the carbureter. The oil is sprayed in at the top of this vessel and is vaporized by the heat of the checker brick; the oil vapors, mingling with the water gas, pass on through the carbureter and superheater; the mixture in its travel between the rows of heated fire brick is converted into a permanent, fixed gas, requiring only the subsequent condensing, scrubbing and purifying treatment to render it suitable for use.

Gas Oil

With the introduction of the water gas process, the gas industry found itself for the first time in a position to use fuel other than bituminous coal. Anthracite coal or coke could now be employed to produce the so-called blue or water gas and by the addition of vaporized petroleum, this non-luminous gas could be enriched to almost any desired luminosity within a reasonable limit. The new process was more flexible, the installation of the plant was less expensive and in addition to its special advantages for use in localities where anthracite coal and oil were readily obtainable, it provided an admirable addition to the existing coal gas plant, in that it could be put into operation with little delay and quite as readily shut down.

Here was a solution for handling the "peak" or heavy load of short duration, and an outlet for the surplus coke produced in the coal gas plant. Oil was easily procurable and at a reasonable price. Naphtha, one of the distillates of petroleum, was found to be suitable for the purpose. The creation of a market for its disposal was welcomed by oil producers and refiners who had regarded it as an oil by-product of little consequence. It is said that naphtha could be purchased for one cent a gallon in the early days of water gas manufacture.

Subsequently the development of other uses for naphtha and the increase in its price led to the use of a heavier grade and less expensive oil. This distillate, because of its applicability to gas manufacture, became known as "gas oil." For many years it too had been regarded as a by-product of the oil refinery and one which oil companies were glad to dispose of at a price which seems to have been principally fixed by its availability for gas manufacturing purposes. Until fuel oil began to come into use, there was little demand for gas oil other than that created by the manufacture of artificial gas; and oil shortages, like Commission control and regulation of rates, weighed not upon the gas man of that time.

Economics of Gas Oil

Gas oil is no longer a refinery by-product. The constantly increasing use of fuel oil has created a demand which gas oil has been, in part, required to fill; but a more serious and important factor in reducing the quantity of oil available for gas manufacture has been the development of more efficient processes of oil distillation. Fractions formerly of relatively low value to the oil companies may now be converted into refined products commanding correspondingly higher prices. The last ten years have seen an enormous increase in the demand for petroleum products of all kinds. The biggest increase of all has been in the demand for motor gasoline, which may now be produced from oils which only several years ago were of negligible value for that purpose, with the result that users of both gas and fuel oil are being gradually forced downward on the scale of gravity and grade.

The gas oil of 34°-36° Baume, is no longer to be had, except in few cases and at such rapidly mounting prices as to be prohibitive. Oil of suitable gas making quality has in a number of cases advanced in price 400% in 5 years. In numerous instances which have come to my attention, gas companies are at present paying twice as much for oil as they were able to purchase it for less than 12 months ago, and contracts assuring a continued supply will no longer be entered into by many of the oil companies who have furnished this essential gas making material in the past.

Influence upon the Gas Industry

Such a condition would be a serious one in any industry, but it reaches alarming proportions in its relation to the gas industry, for there the power to adjust the selling rates for gas does not lie with the public utility company, but is vested in the utility commission, the state, the municipality or other regulatory body exercising control under the laws as they exist in different jurisdictions. Too often the courts must be appealed to for relief from the iniquity of prices fixed by a pre-war statute. It would insult the intelligence of the most ordinary mind to emphasize so obvious a fact that prices adequate to yield a reasonable profit before the war cannot be made to do so under present costs and conditions.

Correction of Unjust Treatment Demanded

Clear and ungrudging recognition of the precarious condition into which gas companies have been forced is necessary to the correction of that condition and to the continuation of an indispensable service. Relief must be afforded and without delay. It must provide not only freedom to charge for gas the reasonable rate that guarantees a fair return upon a fair investment, that is a right which the Constitution confers upon all of its citizens and their enterprises; but relief in the form of revision of the standards of quality under which gas is served is likewise essential.

Search for Substitute for Gas Oil

Earnest and painstaking effort has been and continues to be directed to the development of a substitute for gas oil, i. e., some distillate of a relatively low gravity and with a correspondingly lower value for other purposes. Such substitute oils so far considered are found to have distinct disadvantages, such as reducing the capacity of the generating plant, requiring additional purifying capacity, increasing labor and other difficulties which may not prove insurmountable; but all indications point to the conclusion that no substitute can be had which will make possible the maintenance of such candlepower standards as exist, nor prevent to some extent at least, the downward revision of high heat value standards.

Inequity of Obsolete Candle-power Requirements

Knowledge of the continued existence of candlepower standards may come as a shock to those who might very naturally assume that such a useless and archaic method of evaluation had long ago been relegated to oblivion, yet such standards exist today in New York, Brooklyn and thirty-five other cities in the United States. That this obsolete method of prescribing the quality of manufactured gas is permitted to continue is a sad commentary upon the intelligence of those who persist in the perpetuation of the antiquated laws which demand it.

Candlepower as a means for determining the value of artificial gas ceased to serve any useful purpose when the incandescent mantle burner, deriving its brilliance from the heat of combustion, came into general use and displaced the time honored "open flame," so placing gas for illuminating purposes upon the same basis of heating value utility that governs its use as a fuel for cooking, heating and industrial operations. Great Britain long ago adopted the heat value or calorific standard as the proper one under which gas should be supplied and similar action has been taken in many parts of the United States. Wherever candle-power standards continue in force an economic crime is being perpetrated.

Efficiency of a Public Service Demands Reduction of Calorific Standard

The elimination of candle-power standards is not the only step to be taken in the attempt to solve the oil problem. Calorific standards, in many cases, are unnecessarily high. A rich gas of high heating value is apt to be much more variable in composition and therefore less susceptible to close regulation and the most efficient use than one of relatively low heating value, which it is possible to maintain at a much more uniform quality.

The natural tendency, as the art has developed, has been to reduce the heating value of gas from the higher standards which were formerly favored, for by this is made possible the production of a more uniform gas and one better adapted to the public use than those of high heating value which, as has been pointed out, are usually more variable in character. The opponents of moderate heating values have little upon which to rest their case. The standard of 450 B. T. U.'s which, until recently, existed temporarily in the Dominion of Canada, has now been made permanent, after a period sufficient to demonstrate the practicability of such a value.

Experience and the data at hand have shown that where reductions have been made, no added expense has been imposed upon the user of gas. There would appear to be no argument left for continuing the economic waste of supplying gas of either candle-power or high calorific value standards, and requiring the unnecessary consumption of oil, when gas of a lower calorific value will satisfactorily answer every purpose and without any disadvantage to the consumer. The testimony of those companies operating under reduced calorific standards indicate that there has been no increase in the number of complaints, nor has there been any impairment in the quality of the service rendered. The general trend of thought on the part of those who have devoted their efforts to developing the supply of gas along the lines of most efficient and economical service to the user, is universally in favor of lowered standard. All arguments in the interest of conservation, economy and satisfactory service point that way.

Conservation of Our Resources Vital to the Gas Industry

The conservation of our oil resources is an obligation which rests upon all alike, regardless of the purpose for which oil may be used. It is certain that in non-essential industries the use of petroleum and its products should be curtailed to the greatest possible extent. In industries which serve the public its use should be reduced to the lowest point compatible with good service to the public. An official of the United States Geological Survey is recently quoted as saying:

"The difficulties encountered by the manufacture of gas in obtaining needed supplies of oil raise the question of the available supply of petroleum and what are the most essential uses of its production. These subjects deserve serious attention because of the increasing demands for gasoline, fuel oil, etc., and in the not distant future the public must determine what are the most essential uses of petroleum products."

Clearly, the manufacture of gas is one of the essential uses of oil and perhaps of greater importance to a larger part of the public than any other use for which petroleum and its products are consumed; at least the public is more intimately and directly concerned. But the amount of oil consumed, even for

such an essential service, should not exceed that required to produce a suitable gas which may be economically and efficiently used.

Present Conditions in the Gas Industry

There are now in operation in the United States about 1,024 companies serving manufactured gas to nearly forty-five million people. In 460 plants the water gas process is exclusively employed—and it is operated in 170 plants in combination with the coal gas process. Approximately 70% of the total volume of gas manufactured is produced by the water gas process, and from twenty-four to twenty-six million barrels of oil are consumed annually for this purpose. In other words, thirty million people are served by gas manufactured by processes in which oil is used; so it is evident that the existing oil shortage and its effect upon the operation of gas companies become a matter of more than passing concern to the public.

It is not practicable to substitute plant and processes to produce gas from coal alone, without the use of gas oil or any of the petroleum distillates. The widespread construction of coal gas plants on any such scale is in itself a physical and financial impossibility. The physical replacement of existing water gas plants by plants or processes which do not utilize oil would take years to complete. The fabrication of material and the installation of the plants on such a stupendous scale could not be accomplished in ten years; it would probably take much longer. It may well be asked upon whom is to rest the burden of scrapping and practically throwing away plants and equipment now representing an investment of probably four hundred million dollars, which would require in the replacement an outlay of two and one-half times as much.

Results of Arrested Development in Regulation

The position of public utility companies today, operating under limited rates, which are in many cases inadequate to provide a fair rate of return on the investment, would make it utterly impossible to secure the new capital which would be required for the construction of such plants. One billion dollars would be necessary for this purpose; and not until public utilities are relieved of the excessive regulation to which they are now subjected and not until they are permitted to operate under rates which yield a reasonable and proper return, will their securities attract new capital for any purpose.

To all that has been said in the foregoing must be added the fact that the market for bituminous coal is no more stable than the oil market. The increased demand for coal that would be imposed by the general use of the coal gas process would bring about a condition from which relief would be just as difficult as in the present case.

The Remedy

The remedy is in the adoption of sane standards of quality, the abolition of candle-power standards wherever they exist and the downward revision of high heat value standards to a point where the minimum amount of oil will be used in the manufacture of a uniform gas suitable for satisfactory and economical service to the public. Of equal importance is the broad recognition of the fact that the service rendered to the millions of consumers of manufactured gas is an indispensable one which cannot be maintained by companies operating at a loss.

Over-regulated industry cannot thrive and develop, and the prosperity of gas companies, like that of all public utilities, plays an important part in the prosperity and development of community life.

Personal Items

B. F. Twining, formerly in charge of the laboratory of the Nixon Nitration Works, New Brunswick, N. J., is now with the Barrett Co., Frankford, Phila., Pa.

* * *

Russell B. Stoddard, formerly at the Buffalo plant of the National Aniline and Chemical Co., is now research chemist for the Palatine Aniline and Chemical Co., Poughkeepsie, N. Y.

* * *

Dr. George D. Van Epps, formerly with the Continental Motors Co., Muskegon, Mich., is now associated with the Citro Chemical Co., Mayfield, N. J.

* * *

Harry C. Helmlinger, formerly chief chemist, Dye Products and Chemical Co., Newark, N. J., is now with the Monsanto Chemical Works, St. Louis, Mo.

* * *

C. F. Sims, 120 Broadway, has been appointed New York representative of the Consumers' Chemical Company.

* * *

Dr. William H. Nichols, president of the General Chemical Company and a member of the class of 1870 of New York University, is the largest individual donor to date to the \$6,450,000 endowment fund campaign which that institution is promoting.

* * *

C. A. Newhall, C. E. Bogardus and A. L. Knisely, chemists of Seattle, Wash., have organized as Newhall, Bogardus, Knisely, Inc., and combined their offices and laboratories at 114 Marion street, Seattle. Messrs. Newhall and Bogardus heretofore practiced independently and Mr. Knisely formerly was with the U. S. Bureau of Chemistry.

* * *

A. E. Anderson, vice president, Proctor & Gamble Co., on his return from a five-months' business trip to Europe, said: "European countries are recovering slowly from the effects of the war. Little business is being done. Thousands are idle. They all expect America to solve questions and bring prosperity. In Germany a pound of bacon costs as much as a man makes in a day and a half, and a suite of clothes costs 150 days' pay. Practically all the men, he said, are still wearing military uniforms. European countries are the greatest markets in the world at the present time for soaps, greases and oils."

* * *

Gabriel E. Rohmer of the National Lead Co., 111 Broadway, New York, has been sent to England and the Continent to take care of the interest of his company in Europe.

* * *

Dr. H. S. Riederer, who was engaged in commercial chemical development at the Experimental Laboratories of the Atlas Powder Co., is now with the United Color & Pigment Co., Newark.

* * *

Dr. Charles L. Parsons, secretary of the American Chemical Society, sailed recently for Europe to attend the International Conference on Pure Chemistry at Brussels, Belgium, and also to investigate the nitrate situation.

C. A. Straw has joined the development department of the Standard Oil Co. of N. Y. as patent expert. Mr. Straw is a graduate of Harvard, 1901, with degree of A. B. He was first an assistant in the laboratory of the Naval Torpedo Station at Newport, R. I. He was later appointed Inspector of Powder for the Navy at the Du Pont Works at Haskell, N. J. Later, he was a chemist with the State Board of Health of Massachusetts, and subsequently was with the Du Pont Company Experimental Laboratory at Wilmington, Del. For several years he was an Assistant Examiner in the U. S. Patent Office at Washington. He left to accept a commission as Captain in the Ordnance Department, U. S. A. After discharge from the service he joined the Goodyear Tire & Rubber Co. patent office, Akron, Ohio.

* * *

Sereno P. Finn, vice president and treasurer of the Sherwin-Williams Co., has completed 50 years of service with that organization which began in 1866 as a small retail paint store established by Henry A. Sherwin and which in Mr. Finn's experience has become an industry with world-wide ramifications.

* * *

M. Kobayashi, 65 Broadway, New York, has been appointed New York representative of Mitsui & Co., Ltd., of Japan.

* * *

Lindsley Loring, treasurer of the Merrimac Chemical Company, has been appointed senior vice president. Mr. Loring was vice president and treasurer of the Cochrane Chemical Company for fourteen years, and when in 1916 this company was acquired by the Merrimac Chemical Company, he became treasurer of the latter. William M. Rand succeeds Mr. Loring as treasurer. Frank G. Stantial will become vice president in charge of chemical engineering and research. James Lund will become vice president in charge of production.

* * *

O. H. Hewlett, Jr., formerly associated with Rockhill & Vietor, is now manager of the chemical department of Ralph L. Fuller, Inc., 81 Fulton street.

* * *

John A. Kienle, formerly sales manager of the Electro Bleaching Gas Co., has been appointed general manager of sales of the Mathieson Alkali Works, Inc. This change was brought about by the severing of relations between the Mathieson Alkali Works, Inc., and its former sales agents, the Arnold Hoffman & Co., Inc. It is the intention of the Mathieson Alkali Works, Inc., to sell all of its products (caustic soda, soda ash, Virginia soda, bicarbonate of soda, bleaching powder, liquid chlorine, chlorine solvents, etc.) direct to the consumer instead of through sales agents.

Mr. Kienle has been placed in charge of the development of a complete sales organization. E. E. Routh, formerly manager of bicarbonate sales, has been appointed as assistant to Mr. Kienle. Dr. Benjamin T. Brooks, chemical engineer, also is associated with Mathieson Alkali Works, Inc., with headquarters at the New York office, 25 West 43d street.

Industrial Notes

The Hanovia Chemical Co., Newark, N. J., will build a three-story 40 x 75 ft. factory.

* * *

The U. S. Glue Co. will erect at Carrollville, Wis., a three-story plant, 377 x 500 ft. for the manufacture of edible products, costing \$2,000,000.

* * *

The Troco Nut Butter Co., 30 North Michigan avenue, Chicago, will erect a four-story 100 x 112 ft. plant at 37th and Iron streets, Chicago, costing \$250,000.

* * *

Trustees of Dartmouth College announce the construction of a new chemical laboratory 60 x 150 with a central pavilion 4-stories high and two wings of three stories each, costing \$350,000.

* * *

The Vegetable Oil Products Co. of Pittsburgh, Pa., is building a 20-ton refinery at Los Angeles Harbor to refine oriental peanut and cocoanut oil. It is expected the plant will be in operation about September 1.

* * *

The Franklin Baker Co. of New York has purchased the Bienville brewery property at Mobile, Ala., and will use it as a branch plant for the manufacture of cocoanut and cocoa products, availing themselves of Mobile as a direct port of entry for raw material. In addition to its Brooklyn plant for the manufacture of dessicated cocoanut, the company has just completed an edible oil refinery at Newark, N. J.

* * *

The Nearpara Rubber Co., Trenton, N. J., has awarded a contract to the Bethlehem Construction Co., Bethlehem, Pa., for the rebuilding of its rubber reclaiming plant recently destroyed by fire. The structures will comprise a main one-story works, 100 x 125 ft., and power plant, 30 x 30 ft., to cost about \$150,000.

* * *

The Atmospheric Nitrogen Corporation, formed by interests in control of the Solvay Process Co., Syracuse, N. Y., and the General Chemical Co., has awarded contract to the J. G. White Co. for the erection of a plant at Syracuse to cost about \$1,000,000. E. L. Pierce, president Solvay Process Co., is president of the Atmospheric Nitrogen Corporation.

* * *

The Vinegar Hill Zinc Co., subsidiary of the National Zinc Separating Co., has purchased from the government the contact sulphuric acid plant erected by it during the war at Cuba Hill, Wis. Waste gases from roasting zinc ores are utilized. Shipments at rate of tank car per day are expected June 1st. C. C. Tandy, Plattville, Wis., is the construction engineer.

* * *

The Federal Portland Cement Co., with offices located at Fort Dodge, Iowa, recently organized, is erecting a mill with a capacity of 4,000 barrels a day at Rutland, Iowa. The land and quarries of the company consist of 500 acres of land located at Rutland and 103 acres of shale land at Tara, on the M. & St. L. R. R.

The United Publishers Corporation and the McGraw-Hill Co. furnish an example of industrial integration in the trade paper publishing business in the purchase of a paper mill at Newton Falls, N. Y., where magazine paper and straight book stock will be manufactured for their own needs which aggregate 15,000 tons per year. Operation on account of the purchasers will begin in the autumn.

* * *

The board of trustees of the College of the City of New York has authorized the granting of degrees of chemical, civil, electrical and mechanical engineer on the satisfactory completion of a curriculum requiring five years. The announcement of the details of the curricula will shortly be issued. This is one of the steps taken by the College of the City of New York in the direction of closer cooperation between industry and colleges and universities.

* * *

The National Aniline and Chemical Co. announces that improvements involving an expenditure of over \$300,000 are in contemplation in the indigo department at the Marcus Hook works, including the erection of a four-story building and installation of machinery.

* * *

Alabama By-Products Co., Morris W. Bush, president, has acquired property and business of the Birmingham Coke & By-Products Co., Birmingham, Ala., and will make coke, ammonium sulphate, tar and benzol, using the recently completed plant of 50 Koppers ovens of the Birmingham Coke and By-Products Co., near Boyles, Ala. This plant represents investment of about \$3,000,000. Alabama By-Products Corporation was incorporated under laws of Delaware, with capital stock of \$5,000,000, \$1,000,000 of which is preferred and \$4,000,000 common.

* * *

Sloss-Sheffield Steel & Iron Co. has put in operation 60 ovens at its by-product plant at Birmingham, Ala. An additional battery of 60 ovens is expected to be completed soon. All the ovens are of the Semet-Solvay regenerative type, each with a cooking capacity of 2,500 tons of raw coal in 24 hours. Coke will be produced exclusively for furnace use. Among the products that will be marketed are crude tar, toluol, benzol and motor fuel. It is estimated that in 24 hours there is produced at this plant 1,800 tons of coke, 20,000 gallons of crude tar, 60,000 pounds of ammonium sulphate, and 7,000 gallons of light oil.

* * *

The first unit of the St. Louis Coke & Chemical Co. plant at Granite City, Ill., comprising 80 coke ovens and one blast furnace, will be in operation about the middle of July, if there is no unexpected delay in the delivery of equipment. The blast furnace will have the capacity of 500 tons of pig iron per day, which will be shipped as hot metal to the plant of the National Enameling & Stamping Co. The coke plant will handle 2,000 tons of coal per day, and will produce about 1,500 tons of metallurgical coke from 100 per cent Illinois coal. Part of the coke output will be used in the company's own blast furnace.

The Ajax Electrothermic Corporation, Trenton, N. J., has been incorporated to take over the manufacture of the Ajax-Northrup high frequency furnace from the Pyroelectric Instrument Co. and the Northrup patents from the Ajax Metal Co., Philadelphia. The new corporation will have its offices and works in the old home of the Pyroelectric company, 636 East State street, Trenton, the latter company continuing the manufacture of pyrometers and instruments in other quarters at the same address. The officers are: President, G. H. Clamer; vice-president and technical advisor, E. F. Northrup; treasurer and works manager, H. F. Porter; secretary and sales manager, Dudley Willcox. The Ajax Electrothermic Corporation is controlled by the Ajax Metal Co.

* * *

The University Apparatus Co., 2229 McGee street, Berkeley, Cal., manufacturer of laboratory apparatus, precision equipment, etc., will build a new three-story works near Bancroft Way, to cost about \$16,000.

* * *

The Eastman Kodak Co., Kodak Park, Rochester, N. Y., will build a new power plant to cost about \$200,000, including machinery. A one-story works building will also be erected to cost about \$10,000.

* * *

The du Pont Powder Co., Fairchance, Pa., has awarded contract to the Dravo Contracting Co., Pittsburgh, for the erection of additions to cost about \$50,000 to replace a section of the plant destroyed by fire.

* * *

The Combustion Engineering Corporation, 11 Broadway, New York, has acquired property at 43-47 Broad street, and will soon commence the erection of an eight-story building.

* * *

The Wausau Abrasives Co., Wausau, Wis., has broken ground for a one-story brick and concrete factory, 60x200 feet, which will be equipped for crushing mineral rock and the manufacture of grinding wheels, sandpaper and other abrasive specialties. J. K. Sawyer is general manager.

* * *

The Standard Oil Co., 200 Bush street, San Francisco, has awarded a contract to the Foundation Co. for additions to its refinery at Richmond, to cost in excess of \$5,000,000. Among the structures to be erected will be a mechanical and machine shop, to cost about \$1,500,000, including equipment. A club building for employees is estimated to cost about \$125,000.

* * *

The Synthetic Rubber Products Co., Elkhart, Ind., has been incorporated in Delaware with capital of \$3,000,000 by Ernest W. Lohrman and Alexander C. Sievers, both of Elkhart, to manufacture rubber specialties.

* * *

The Bath Portland Cement Co., Finance building, Philadelphia, is considering preliminary plans for its proposed plant on property recently acquired at Sandt's Eddy, Pa., estimated to cost over \$1,000,000.

Equipment at Swartz, La., to cost about \$300,000 will be installed at the new plant of J. M. Huber, 602 Sixty-second street, Brooklyn, manufacturer of colors. The Hope Engineering Co., Mount Vernon, Ohio, is the engineer.

* * *

The Seminole Fertilizer & Oil Co., Duval building, Jacksonville, Fla., is having plans prepared for a new three-story plant, 70x200 feet, in the vicinity of Cayce, S. C., to cost about \$300,000 including equipment.

* * *

The Norton Co., Worcester, manufacturer of abrasives and abrasive wheels, will double the capacity of its abrasive storage and abrading department by the erection of a large building, dimensions of which have not yet been settled. The company produces the crude abrasive ore in its electric furnaces at Niagara Falls and ships it to Worcester for milling and grinding. In the new building milling equipment will be installed, together with storage bins in the form of huge wooden cylinders, 40 feet in diameter and 40 feet high. Employment will be given to 100 additional men.

* * *

The United Fertilizer Co., Carrollville, Wis., has engaged Herman J. Esser, architect, 403 Camp building, to design a one-story factory building, 100x100 feet, costing about \$75,000 equipped.

* * *

The Manhattan Rubber Mfg. Co., Passaic, N. J., manufacturer of mechanical rubber products, is planning for extensions and improvements to cost about \$30,000. The company has commenced the erection of a new rubber reclaiming plant at Montville, N. J., to cost in excess of \$200,000.

* * *

The Premier Rubber & Insulating Co., Dayton, O., manufacturers of hard rubber and bakelite products, to provide greater plant facilities, has increased its capital stock from \$100,000 to \$250,000. William Grether, of Dayton, is president and treasurer.

* * *

The General Asphalt Co. has increased the capacity of its refinery at Maurir, N. J., from 1,000 to 3,000 barrels per day. The company's new plant at Madison, Ill., for the distillation of natural asphalt, is just getting under way.

* * *

Baker & Co., Inc., Newark, N. J., manufacturer of platinum wire, etc., has filed plans for a two-story shop, 38x50 feet, to cost about \$36,600.

* * *

A one-story power plant, 50x100 feet, to cost about \$25,000, will be erected by John Campbell & Co., Newark, N. J., at their chemical works in connection with the construction of an addition to cost \$108,000.

* * *

The Certain-Teed Products Corporation, First National Bank building, San Francisco, manufacturer of roofing, etc., is having plans prepared for a three-story brick and reinforced concrete plant at Richmond, Cal. Headquarters of the company are at St. Louis.

CHEMICAL AGE

A CONSOLIDATION OF THE CHEMICAL ENGINEER and CHEMICAL AGE

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Private Enterprise *versus* Government Operation in the Chemical Industry

In the hearing before the Senate Committee on Agriculture and Forestry to determine the disposition of the War Department's investment for munitions production during the war, made at Muscle Shoals (Nitrate Plant No. 2) and Sheffield (Nitrate Plant No. 1), Alabama, Frank W. Washburn, president of the American Cyanamid Co. and also president of the Air Nitrates Corporation which constructed for the government the Muscle Shoals plant, was heard in final rebuttal of the testimony of the government experts.

Mr. Washburn's testimony concluded the Committee hearings reprint of which constitutes not only a popular textbook on the subject of nitrogen fixation, but is a curious reflection of the mental aberration of government scientists which has not its counterpart outside of a prussianized Germany or a sovietized Russia.

We would not expect to find the proponents of the nationalization of industry, represented by government scientists and the Secretary of War, sharing the same breast with the Federal Trade Commission. How Tom Johnson, were he alive, would have gloried in the apotheosis of his protégé!

Excerpts from Mr. Washburn's testimony follow to show the tragic predicament the government found itself in as regards munitions on our entering the war, the relation to the government of the American Cyanamid Co. in the efforts of the latter through the Air Nitrates Corporation to supply the deficiency, and the present bitter cordiality of these respective groups to maintain on the one hand the inviolability of contract, and, on the other, to subvert the principles of democratic government that some habitues of the Cosmos Club may have a commercial plant labora-



FRANK W. WASHBURN.
President, American Cyanamid Company.

tory for the study of the art of nitrogen fixation, and incidentally to turn upside down the business of a basic industry.

Qualifications of the American Cyanamid Co.

Mr. Washburn, referring to Col. Joyes' prior testimony as to the degree of importance of the American Cyanamid Co. to the situation which confronted the government at the time the company was asked by it to build the Muscle Shoals plant for the production of ammonium nitrate, says:

"He said there are four essential steps in the process: (1) The manufacture of cyanamid which, he said, was one which the American Cyanamid Co. strictly and solely controlled as well as had experience in; (2) conversion of cyanamid into ammonia; (3) the oxidation of ammonia to nitric acid, as to which processes the Cyanamid Co. had some experience, although it could not be said that it controlled them; (4) the combination of a portion of the ammonia with nitric acid to form ammonium nitrate, neither was controlled nor was it a matter in which the company had had experience.

"The fact is that the American Cyanamid Co. at the time it undertook this work for the government had been operating for a considerable period the largest single plant in the world for the transformation of cyanamid into ammonia. The only other plants outside of Europe were built by the American Cyanamid Co.; put in initial operation by the staff of that company, and placed at the disposal of the companies which used them under a contract by which they were obliged to purchase all the cyanamid used in these plants from the American Cyanamid Co., and under the further obligation that whenever they should cease to buy raw material from that company, they

should cease to use the plants and turn them back to the American Cyanamid Co.

"In other words, our experience in and control of the second step was just as great as our experience in and control of the first step; and I am quite confident that the government representative in expressing his opinion somewhat to the contrary did so through lack of knowledge of the relations between our company and these other companies which used this process.

"The third step, viz., the oxidation of ammonia to nitric acid, was practiced by the American Cyanamid Co. at its New Jersey plant under exclusive patents owned by it. The art was not practiced elsewhere on this side of the Atlantic. While our capacity was small, the units employed in that plant were of the same size as were later installed in greater number at Muscle Shoals, and which were eminently successful there. The company possessed, so far as was known at that time, the only successful method of oxidizing cyanamid ammonia to nitric acid.

"The Ostwald process, the patents of which were owned by the English Cyanamid Co., had proved, as one of the other witnesses testified, unsuccessful in commercial application. The process of the American Cyanamid Co. was essentially the same as that so successfully employed in Germany during the war in the manufacture of nitrate nitrogen, but we believe an improvement thereon.

"There was still a third, but experimental and unperfected process,* known in this country which was believed to have merit and which we were strongly urged by certain government commissions to install in place of our own. Notwithstanding every effort on the part of the government to develop this process during the war, it was not brought to a workable state. Shortly before the signing of the armistice, a sample apparatus† was turned over to us with the request that we should endeavor to develop it into a practicable process.

"The fourth step was one in which we had had no experience whatsoever, and the recommendations and advice which we received from those who manufactured ammonium nitrate by the usual methods proved to be wholly impracticable, while our own process devised by the research department of the American Cyanamid Co. proved from the first to be entirely successful and gave a product superior in quality to any which the government received from other sources, and superior to the specifications for the material given us by the Ordnance Department.

"In short, I think that our contribution was of equal importance in each of the four steps involved in the manufacture of ammonium nitrate from atmospheric nitrogen.

Compensation of American Cyanamid Co.

"As regards the matter of compensation to the American Cyanamid Co., there were read by one of the government representatives extracts from certain letters addressed by the American Cyanamid Co. to the government during the period of negotiations relative to the construction and operation of the nitrate plants. They were read for the purpose of indicating that the company wished an unreasonable compensation for its war work as distinguished from an effective protection from the destructive competitive effects of these plants should they be placed in commercial operation after the war.

"As I have already told you, the one serious ques-

tion at issue between the government and the company in those negotiations was the matter of protection of the company from what one of the principal advisers of the government at that time designated as 'A monster which would thus be reared by the United States government for the devouring of the American Cyanamid Co.'

"The letters, arguments and exchanges of views that came to the surface were all expressions of an effort to commute in terms which should be adopted eventually as the best protection for the company practicable of accomplishment.

"The company's offer in more than one meeting with the Chief of Ordnance and the War Industries Board was to undertake the work desired by the government without any compensation whatsoever, except the payment of bare expenses, providing the government would bind itself to pay a royalty on the commercial product at a figure which was tentatively fixed at 40 cents per unit of ammonia, substantially equivalent to \$11 per ton of lime nitrogen.

"The opinion of the government attorneys, which opinion at that time was coincided in by our own attorneys, was that no such protection could be legally given by the government; and if placed in the contract would be extralegal, and therefore not capable of being carried into effect.

"May I ask that you place yourselves in our position and assume, if you choose, that you are contemplating an investment under these conditions in the stock of the American Cyanamid Co.? Here was a plant to be constructed which had a capacity for the production of nitrogen by the cyanamid process equivalent to four times the capacity of the company to produce and about six times what the markets at that time under peace conditions would absorb. Had you been informed that the Cyanamid Company was expecting to build such a plant/ what would you have devised as a means of protecting the company against its future commercial operation, possibly in the hands of the government, whose purpose would be to sell substantially without profit, and which in any event does not include in its costs of merchandising and manufacturing interest, amortization, obsolescence, depreciation, local and state taxes, federal taxes, insurance, legal expense and advertising?

"You must appreciate what the effects upon the American Cyanamid Co. would be to dump upon the American market four times as much nitrogen as it could produce in its own plants and under conditions in which the object is not commercial gain on the part of the competitor, who is relieved from costs, the combined amount of which is far greater than any profit which normally accrues to the industry. How would you have gone at it? Try as we would on both sides, we were unable to accomplish the result. The only thing in which even partial protection to the company could be commuted was a monetary return to the company and a small and uncertain royalty. These, in the nature of things, were bound to be wholly inadequate, and, furthermore, very uncertain of application in the final analysis.

"And what was the result? It was an agreement under which the American Cyanamid Co. was to receive as a fee for designing, planning and constructing the plant a maximum under any circumstances of \$1,000,000. It was wholly improbable—in fact, impossible—that the net return to the company should even approximate this amount, for out of it must come salaries paid to those of the staff of the American Cyanamid Co. who were assigned to carrying on the

*Haber process.

†Nitrate Plant No. 1.

government's work, practically to the exclusion of everything else, and whose salaries for this period amounted to over \$200,000.

"It was impossible in the nature of things and is the experience of practically every contractor who undertook construction work for the government that all the expenditures of the company would be borne by the government, notwithstanding this agreement that it would do so. It was not reasonable to expect, and it was not in accordance with anyone's experience that millions of dollars' worth of work could be done for the government and there be no items, however carefully matters were handled, which the government would decline to pay.

"Then there was the inevitably large federal war

for commercial uses the American Cyanamid Co. should have adequate compensation. This was thrown in as a forlorn hope, and, as you know, was eventually stricken out in a substitute contract made at the time when the government asked us to undertake the construction and operation of two additional plants.

"I very much doubt whether any of you gentlemen would have invested in the stock of the American Cyanamid Co. under these circumstances and conditions.

"I have made it as plain as I know how to make it that I believe the Muscle Shoals plant should be conserved to the country as a great industrial plant. I differ from the administration's point of view in that to start the plant now would be an economic loss

Frank W. Washburn

Excerpt from Minority Report of the Select Committee on Expenditures in the War Department.

Throughout the majority report there run the threads of suggestion of sinister and unworthy motives on the part of Mr. Frank S. Washburn, president of the American Cyanamid Co., which is the owner of the patents of the cyanamid process of nitrogen fixation. The effort is manifestly made to connect up those responsible for its projection with him and to create the impression in the public mind that they aided in the furtherance of these alleged sinister and unworthy purposes. The majority regret the necessity of discussing individuals.

We do not deem it to be our function or any part of our duty to defend Mr. Washburn any more than it would be to persecute or prosecute him. It is our business to state facts. These should be stated in justice to him and his associates in business, who, in their appearance before the committee, had all the bearing of gentlemen and good citizens.

Mr. Washburn is a man, we judge from the record, of large affairs. Certainly his appearance and testimony show him to be a man of great vision. His life, so far as we have reviewed it in the evidence, has been devoted to productive industry, the creation of life's essentials. One, perhaps his chief interest during recent years, has been the development of processes for the production of nitrogen, an indispensable necessity. He has approached this work, not only as a philosophic scientist, but as a practical business man, a combination rare enough to excite more than ordinary notice.

If Mr. Washburn's designs, therefore, could by any possible stretch of the imagination be distorted into something bad, the fact that within 5 miles of the very point which he had for years regarded as the most available place for the establishment of the industry in which he was interested financially, there was constructed first a plant which was to use a rival process (Nitrate Plant No. 1 at Sheffield, Ala., modified Haber process), would certainly dispel any theory as to the officials of the Government being swayed by him in the carrying out of his evil designs.

The truth and the whole truth is, that during the years while Mr. Washburn was considering the power development and nitrate construction plans at Muscle Shoals, he came before committees of Congress, appeared before the engineers of the War Department, and presented his suggestions and urged them with all the force of his highly-developed and well-trained intellectual powers. He came in the daylight. There was nothing secretive in his methods and nothing in his conduct upon which to hang the slightest suspicion of an intention to do aught that was concealed or that violated the most delicate sense of propriety.

The question of whether his proposition was a good one, a desirable one from the Government's standpoint when presented, is not involved. That was a question for Congress upon its responsibility. The only pertinent thing here is the matter of his methods, and there is nothing in this record or in any other accessible record to justify the slightest aspersion or criticism of it.

So much we say as a matter of justice to a private citizen who, by reason of having done war work for the Government, finds himself in the unfortunate attitude of being reflected upon by the majority of this committee which at times seem determined to blast the good name and fair repute of every citizen, whether in official or private life, who rendered services to the country in its hour of stress.

taxes which apply to the remainder, whatever that remainder might be. The operating and royalty fees which were to be paid the company in addition to its construction fee just referred to were problematical and dependent upon the continuance of the war—and, as it proved, amounted in total sum, as far as I recall at the most to about \$15,000. Then there was the final understanding that if the plant should be used

instead of an economic gain to the country. Whenever the plant shall be placed in operation it should be under the management of a private organization and not as a government operation."

A concise summary is made in the following table of Mr. Washburn's presentation of the determining factors in the situation which confronts the government as regards the disposition of the plant.

GOVERNMENT CONTENTION

FACTS AND CIRCUMSTANCES AS PRESENTED BY FRANK W. WASHBURN

Economic Considerations

Nitrate Plant No. 2 at Muscle Shoals, Ala., will produce fertilizer and rescue the farmer from the exactions of the "fertilizer trust" and free him from dependence on Chilean nitrate.

There is great need for ammonium sulphate which only can be supplied by operation of Nitrate Plant No. 2.

Ammonium sulphate which it is proposed to make at Muscle Shoals constitutes only 10 per cent. in cost of all the materials used in fertilizers.

Ammonium sulphate production capacity of the United States is two and one-half times what it was at outbreak of the war, and sufficient not only for all domestic requirements but to provide increasingly large quantities for export.

To operate this explosives (ammonium nitrate) plant is to salvage a \$62,000,000 plant for the government.

Commercial operation of the plant will result in net profit to the government.

Necessary for government operation of this explosives plant to develop art of fertilizer manufacture.

Construction of the Muscle Shoals hydroelectric power plant is necessary to supply power for fertilizer manufacture.

Normal peace-time value of that part of plant usable under the government plan is only about \$15,000,000. It will require not less than \$38,000,000 of additional capital to place in operation for ammonium sulphate production this part of the existing plant.

Even though we exclude from the government estimate of costs of production the essential items of private enterprise, as interest on moneys already expended, amortization, obsolescence, depreciation, local, state and federal taxes, insurance, legal expense, advertising, etc., there will be no profit even with the assumption of full capacity operation. On basis of one-third capacity operation there will be a deficit of \$1,500,000-\$2,000,000 per annum.

Products set forth by administration representatives as new and unique and which are to be developed experimentally at Muscle Shoals are today manufactured in tonnage volume. Additional plants are being erected employing the practical principles that now are mainly bureaucratic dreams. Patents covering these processes are exclusive and the property of private enterprise.

Existing steam electric plant is of ample capacity and will cost the government no more for operation than the proposed water power plant.

Military Considerations

Necessary promptly to operate the explosives plant for peace uses of fertilizer, to preserve it from destruction. Administration plan contemplates that 80 per cent of the acid plant, roughly half of the whole plant, will remain indefinitely in idleness, and as soon as the water power plant can be completed the steam electric plant would become idle.

In event of war a prohibitory length of time would be required to put the idle plant in full operation.

The 150,000 tons of nitrate of soda now held as a military reserve can be sold when the Muscle Shoals plant shall be placed in operation.

The processes by idleness would become obsolete.

Under any conceivable plan a very large part of the plant will of necessity remain in idleness until it is required to its full capacity for the particular purpose for which it was constructed, viz., the manufacture of the explosive, ammonium nitrate, for military purposes. The entire plant can remain in temporary idleness for from five to ten years under proper care and inspection with less deterioration than would be involved in its use.

Experience with this very plant has shown that it would be practicable to place the whole plant in full operation within a period of not more than four months.

A year would be required to produce the equivalent of 150,000 tons of nitrate of soda, necessitating very great additional expenditure in the way of plant and equipment and operation of new processes, for delivery to the various powder plants. Such diversion of plant from its intended war purpose would mean shutting down half the capacity of the plant, for there would be no use for the ammonia therein produced.

Present processes yield a product of exceptional superiority. Under any circumstances production costs of this plant would not be increased by reason of improvements which might otherwise be made in procedure.

Political Considerations

Government operation of the plant neither will destroy nor even discourage private enterprise.

as this proposed Senate Bill No. 3390, will be affected seriously by government manufacture of ammonium sulphate. Discouragement of this industry means limiting the otherwise available supply for war uses of by-product materials of far greater importance than ammonia or ammonium sulphate. It discourages the conservation of approximately one-third of the heat units in coal coke for metallurgical and domestic purposes. Uncertainty, discouragement and loss will result inevitably to the fertilizer industry of the United States by entrance of government into this field, involving far-reaching ulterior effect upon the farmer far exceeding any benefit which government-operated plants could possibly hope to se-

The by-product coke-oven industry which hopes to attain by 1925 an annual production of 1,000,000 tons of ammonium sulphate, unless there is adverse legislation such

cure. The announced intention of the Secretary of War to put the government on a grand scale into the business of generation, distribution and sale of electric power will discourage and check future development of central station power companies all over the United States. The announced purpose of the administration to produce cyanamid fertilizer, incidentally a right which this government does not possess, and sell it to the customers of the private cyanamid manufacturers; and its announced purpose to pay one-third to one-half the royalties provided for in contracts with private parties under which the Muscle Shoals plant was constructed, would mean serious crippling of present cyanamid manufacturers.

Senate Bill No. 3390 proposes a federal corporation, as described by Arthur Glasgow in the May issue of Chemical Age.

tion, distribution and sale of electric power; of quarries; of laboratory and experimental plants for furnishing nitrogen products to the United States. It places government property of a value of \$125,000,000 in charge of a corporation with directors appointed and removed at the pleasure of the Secretary of War, who fixes their salaries,

Enactment of such legislation starts the nationalization of the fertilizer industry, both domestic and foreign; the nationalization of electric power plants; the genera-

to which extent only are they interested financially in the corporation. The bill permits the directors, by authority of the president, to condemn lands, materials, minerals and processes, patented or otherwise, useful in the manufacture of fertilizers and other products, by water power or any other power.

The Zinc Industry of New Jersey

By J. Stewart McKaig

Mining Engineer, New Jersey Zinc Co.

While zinc deposits occur in about every state in the Union, production in 1917 having been reported from 23 states, 86.6 per cent. of the total output is supplied by six districts.* These are (1) Missouri-Kansas-Oklahoma district, (2) New Jersey (Franklin furnace), (3) Montana (Butte), (4) Wisconsin, (5) Colorado (Leadville, Red Cliff and Breckinridge) and (6) Idaho.

The first named is the largest zinc producing region in the world and has contributed approximately one-seventh of the world's annual output in recent years. The ore is typically zinc-lead and contains no precious metals.

New Jersey, the second largest producer, is remarkable for the unusual character of the ore in its single important district, Franklin Furnace, in Sussex County, where is located the largest zinc mine in the world. The ore deposits are distinctive in that they are the only ones of their kind in the world. The peculiar purity of the ore and its abundance and grade have been the foundation of the success of the largest single zinc producing corporation in the world.

Early History of the Franklin Mine.

There is some evidence that the ore deposits at Franklin were discovered prior to 1660, but the first authentic records are of a shipment to England in 1774 by Lord Sterling, who thought it was copper. Nobody ever heard what became of it.

Iron ore was mined and smelted in small charcoal furnaces before 1800, and in 1810 the zinc ore was analyzed and described by Bruce.

The original set of standard weights and measures were accountable for the first spelter produced in this country and made from Franklin ore. The Government, desiring to have them made from native material, imported Belgian workmen to reduce the metal from the Franklin ore.

No attempt was made to work the deposits until 1848 when leases were granted to a number of different companies, some to mine the iron and others zinc. As the minerals were all mixed up together a series of litigations followed which lasted for about 50 years. The company with a lease for zinc would get an injunction against the iron lease and vice versa. One jury, after hearing testimony for six weeks, and retiring to form their decision, sent for the judge and asked what they were to decide. Finally, by a series of combinations starting in 1880, the companies were all brought together under the head of the present New Jersey Zinc Company.

Ore Reduction.

On account of the large iron and manganese con-



FIG. 1. ORE-SEPARATING PLANT OF THE NEW JERSEY ZINC CO. AT FRANKLIN FURNACE, N. J.

Owing to the necessity of having a cleanly separated product, refinement in sizing, magnetic separation, jigging and tabling surpasses that practiced in any other ore separation in the United States, 97 per cent. of the total mineral content of the ore being recovered.

tent it was not commercially profitable to make spelter from the Franklin ores, but a plant was built at Newark in 1851 to make oxide in reverberatory furnaces. The oxide was of poor color and the recovery low so the works superintendent was sent to Europe to study methods. As a result, muffle furnaces, charged with a mixture of ore and coal, were adopted, giving a better product but no better recovery. One night a workman threw a shovelful of the mixture of ore and coal to cover a flue leak and later noticed a zinc flame and cloud of oxide. The present method is based on this discovery.

Some spelter was made from blast furnace flue dust and refuse oxide, but until the magnetic separation of the franklinite from the willemite was made possible by the development of the Wetherill-Rowand magnetic separator, none was made direct from the ore.

Spiegeleisen was also made in the early days, the first blast furnace being erected in Newark in 1855. The hard iron was used for lining safes and with the advent of the Bessemer process more furnaces were put up.

Ore Deposits and Mining Methods.

The Franklin ore body consists of layers of varying mixtures of ore and calcite from 12 feet to 100 feet thick, laying in the form of a U with one leg cut off. The basin of the U pitches from near the surface at the south end to a depth of about 1,100 feet at the north end. A second ore body at Sterling Hill, three miles south, is practically the same as at Franklin.

The ore is mined mainly by transverse stopes, 17 feet wide with a 35-foot pillar between stopes. The mining is carried from the bottom of the deposit upward to the surface, the ore being allowed to fall through chutes to the haulage ways, loaded in cars and pulled by electric locomotives to the shaft where it is hoisted to the mill. The pillars are later mined by the top slicing method, starting near the surface and working downward, the ground being allowed to cave in as the slices proceed downward.

*Report of address by Mr. McKaig before the May 10th meeting of the New Jersey Chemical Society.

The ordinary zinc deposits of the United States are sulphides or carbonates, while the principal ores at Franklin are silicates and oxides. In general, the separated products from the mill are: 36 per cent. franklinite, an oxide of zinc, iron and manganese; 18 per cent. willemite, a silicate of zinc; 16 per cent. half and half, a mixture of impure minerals mainly garnet and rhodonite; 12 per cent. fines and 18 per cent. calcite or tailings. The tonnage of ore treated is about 2,000 tons per day.

Procedure of Milling

The ore is first passed over a picking table where any pieces of calcite, garnet or other non-zinc bearing rock are discarded. It is crushed down to one-tenth of an inch by a series of crushers and rolls, and then passed through dust separators to remove the fine sizes which cannot be separated economically. In order to insure a good separation in the magnetic separators and jigs it is necessary to have the grains of ore in the feed as nearly as possible of the one size. This is accomplished by a series of screen towers which divide the ore into, fourteen sizes, grading between one-tenth of an inch and 100 mesh.

Each size is fed directly to Wetherill-Rowand magnetic separators, which take out, on the first poles, clean franklinite, next half and half, a mixture of foreign minerals, and leave a clean tailings of willemite and calcite, which are non magnetic. The magnetic separators consist of a series of high intensity magnets with the upper poles beveled to an edge giving a concentration of the magnetic lines. The ore is passed between the poles on a conveyor belt in a thin layer. A small take-off belt moves along the magnet pole at right angles to the conveyor. When the ore is attracted to the magnet it strikes this take-off belt, is carried outside of the magnetic field and discharged.

The willemite and calcite tailings are separated on jigs and tables.

There are now four separated products to be shipped to the smelter located at Palmerton, Pa.: (1) willemite

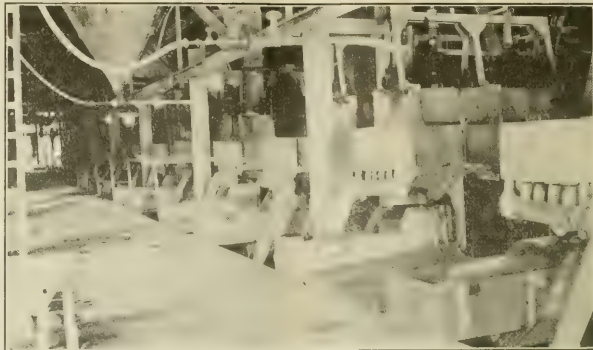


FIG. 3.—VIEW OF JIGS AT FRANKLIN MILL OF NEW JERSEY ZINC CO., AT FRANKLIN FURNACE, N. J.
The jigs effect separation of Willemite from Calcite. The building, 100 x 120, contains 32 magnetic separators and 32 jigs.

for zinc or spelter, which latter term is being discarded as a description of metallic zinc; (2) franklinite for oxide; (3) half and half, and (4) fines, which are mixed together, for oxide.

The spelter furnaces consist of a number of retorts in which the willemite is reduced and the metal drawn off. The willemite being a lead and cadmium free ore makes an extremely pure slab zinc, especially well adapted to the manufacture of slush castings, and for galvanizing articles which have to withstand bending, such as telephone or telegraph wires. It is also used in the manufacture of high grade brass for spinning and drawing purposes.

"Franklin" metal is extensively used in the galvanizing industry and in the manufacture of brasses not requiring high ductility. Both metals are used to a certain extent for conversion into oxide by the French process.

Manufacture of Oxide.

The oxide furnaces are very similar to an ordinary fire box, the flue in this case being connected to a suction fan which discharges into a bag room. The grate is first bedded with a small layer of coal and when well ignited a mixture of franklinite and coal is spread over it. The zinc is reduced by the coal and an excess amount of air blown through the grates converts it to oxide. The mixture of gases and oxide is blown into the bag houses where the oxide is caught on the inside of the bags and the gases pass through. When the bags are shaken, the oxide falls down, is collected and taken to the packing department. Oxide furnaces are usually worked in blocks of twelve and the operation made continuous by charging one furnace at a time. It takes about 8 hours to work off a charge.

Uses of Zinc Oxide

The two great uses for oxide are paint and rubber. The average per cent. by weight of zinc oxide in rubber compound is 55 per cent., and about 98 per cent. of the oxide used in the rubber trade is made from Franklin ores. Fillers were first compounded in rubber to reduce the price per pound and all sorts of materials

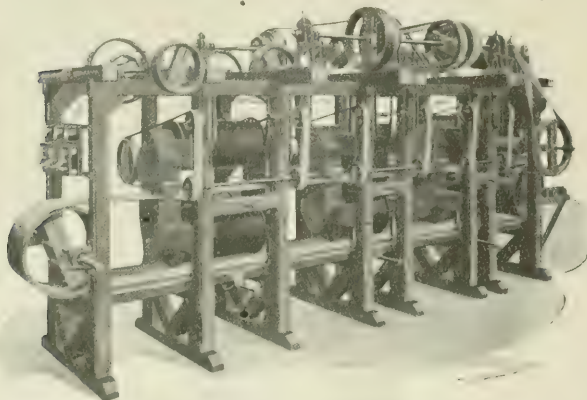


FIG. 2.—ROWAND-WETHERILL MAGNETIC SEPARATOR.
The preparation of metallic zinc from the Franklin ores is due to the development of the magnetic separator, which made possible the separation of Franklinite and other magnetic minerals from Willemite, previous to which the ore could be used only for oxide because of the high iron and manganese content.

were tried. Pure zinc oxide, such as is made from Franklin ores, was found to give the best results and also to improve the wearing qualities and elasticity of the pure rubber. Carbon black when used will give somewhat better results at first but the compound soon hardens and loses its properties. The growth of the automobile manufacture and use of rubber for tires have made the demand for pure oxide for this purpose to exceed greatly its use as a pigment, where a lower grade oxide may be used. Three factories alone in Akron turn out a total of about 90,000 tires a day, and when you consider that 55 per cent. of the rubber compound came from New Jersey zinc oxide an idea of the huge quantity used and spread over the roads of the United States can be formed.

French process oxide is made by burning slab zinc

in an excess of air. It is usually somewhat freer from carbonaceous matter and whiter in color. It is used in making high grade enamels, printing inks, toilet preparations, false teeth, dental cement, white shoe and glove cleaners, matches, enamel ware, celluloid, artificial ivory and a great number of other preparations.

U. S. P. Zinc Oxide, made by the French process from the purest spelter, was used extensively in the war in the form of an ointment to protect the soldiers from gas. Hundreds of tons were made for this purpose.

Zinc dust, made by burning or atomizing slab zinc in a reducing atmosphere, is used in the dyeing industries for color reduction and in cyanide work for gold and silver reduction.

The Canned Milk Industry of the United States

A branch of the chemical industry whose remarkable development since pre-war days has attracted little attention outside of its special field is the manufacture of condensed milk and evaporated milk.

Chemists and bacteriologists have placed a business dealing with a highly perishable product as a raw material upon such a standardized basis that canned milk manufacture has become one of the most scientifically controlled branches of the chemical industry.

The technical man in this business is responsible for the following accomplishments:

1. He has enabled the manufacturer to meet all existing government standards safely at all times without the loss of butter fat or total solids due to variations of the finished product in the course of manufacture.

2. He has furnished the manufacturer with accurate reports of milk products going into a case of finished goods.

3. He has enabled the manufacturer to keep a close check on plant losses.

4. He oversees the quality of fresh milk received at the door with regard to sanitation.

5. He insures accurate sampling and testing of patrons' samples so that both the patron and manufacturer are protected.

6. He oversees the daily sanitary inspection of the factory and insures the manufacturer against loss from spoilage due to unsanitary conditions and protects the public by furnishing them food products in concentrated form, manufactured under the best possible sanitary conditions.

7. He has placed the milk industry on a solid foundation, and enables the manufacturer to expand his enterprise, knowing well that he can figure as to the cost of any one product before he plans its manufacture.

In the four years 1916 to 1919 the total annual production of condensed and evaporated milk in this country increased from slightly over 992,000,000 pounds to over 2,000,000,000, or more than 100 per cent. The tremendously increased demand for overseas shipment for our own armies and the Allies, with contracts made on a "cost-plus" basis, stimulated production to such an extent that the capacity of many factories was increased and many new plants were established.

PRODUCTION AND EXPORTS OF CONDENSED AND EVAPORATED MILK.

Year	Production Pounds	Exports Pounds	Percent- age ex- ported Per Cent.
1914.....	.....	22,850,994	..
1915.....	.....	75,689,584	..
1916.....	992,364,000	219,686,127	22
1917.....	1,333,787,000	428,673,213	32
1918.....	1,875,934,000	551,139,754	33
1919.....	2,030,958,000	852,865,414	42

In connection with this impetus to production it is of interest to note that just prior to the war the condensed milk industry in the United States was more or less disturbed under the influence of a domestic production which exceeded the existing demand, both domestic and foreign. The war demands of European countries saved the industry from what appeared to be an approaching crisis.

The reaction from war conditions produced a bad situation until the recent shortage of sugar affected the market. Under pressure of economic readjustment between countries this country suddenly found the export demand greatly reduced because of the exchange situation, the increased production of condensed and evaporated milk in foreign countries and accumulated stocks in warehouses abroad. Manufacturers realized they must readjust their factory operations to meet these conditions. Three things they could do to avert financial losses to themselves: (1) Curtail production by closing factories; (2) reduce the cost of milk purchased by paying farmers lower prices for milk at their factories, and (3) through advertising and salesmanship increase the domestic and foreign demand. The manufacturers are using these methods which should slowly bring about a readjustment of existing conditions.

Sweetened Condensed Milk

The production of sweetened condensed milk (whole milk product, case goods) in 1919 in the United States amounted to 573,043,671 pounds, or 39 per cent. above the 1918 production. With the exception of January there was an increase during every month of 1919 over the corresponding month of 1918. In May, 1919, the increase amounted to nearly 23,000,000 pounds more than the production during May, 1918. With the exception of July and October the increase tended to diminish throughout the rest of the

year. In December, 1919, it amounted to approximately 7,000,000 pounds more than in December, 1918. Sweetened condensed milk was manufactured in 104 factories in eighteen states during 1919 compared to ninety-eight factories in fourteen states in 1918. The states occupying the first six places in the production of sweetened condensed whole milk, case goods, during 1919 and 1918, are listed below in the order of importance:

PRODUCTION OF SWEETENED CONDENSED WHOLE MILK IN THE SIX PRINCIPAL STATES IN THE INDUSTRY IN THE UNITED STATES, 1919-1918.

1919.	Pounds.	1918.	Pounds.
1—New York.....	325,859,685	1—New York.....	215,825,237
2—Illinois.....	62,980,480	2—Illinois.....	55,362,529
3—Wisconsin.....	49,692,409	3—Michigan.....	41,026,506
4—Michigan.....	47,632,435	4—Wisconsin.....	40,644,203
5—Pennsylvania.....	41,471,443	5—Pennsylvania.....	21,364,121
6—Vermont.....	24,090,797	6—Vermont.....	19,056,676

Inasmuch as New York produces well over one-half of the total manufactured in the United States, and the above six states over 95 per cent., the industry can not be considered widespread. All six states showed a material increase in production over 1918, with the largest actual increase in New York, 110,031,448 pounds.

Unsweetened Evaporated Milk

The production of unsweetened evaporated milk, unskimmed, case goods, in the United States during 1919 amounted to 1,194,496,107 pounds, an increase of 278,058,188 pounds, or 30.3 per cent., above the previous year. Although there was an increase in production during every month of the year compared with the corresponding months of 1918, the increase tended to become larger during the first half of the year and smaller during the latter half. Evaporated milk was manufactured in 156 factories in twenty-four States in 1919 compared to 139 factories in twenty-seven States in 1918. The States occupying the first ten places in the production of unsweetened evaporated milk, unskimmed, case goods, during 1919 and 1918 are listed in the order of importance as follows:

PRODUCTION OF UNSWEETENED EVAPORATED MILK UNSKIMMED IN THE TEN PRINCIPAL STATES OF THE INDUSTRY IN THE UNITED STATES, 1918, 1919.

1919.	Pounds.	1918.	Pounds.
1—Wisconsin.....	378,514,490	1—Wisconsin.....	280,690,026
2—Washington.....	126,091,712	2—Washington.....	132,489,571
3—Michigan.....	120,757,548	3—Illinois.....	92,643,787
4—Illinois.....	103,360,444	4—Michigan.....	74,994,280
5—Pennsylvania.....	88,831,988	5—Pennsylvania.....	61,049,267
6—Ohio.....	88,796,950	6—Ohio.....	54,294,061
7—New York.....	82,829,536	7—California.....	45,235,879
8—California.....	63,660,408	8—New York.....	37,466,914
9—Oregon.....	32,189,906	9—Oregon.....	30,775,483
10—Utah.....	19,106,241	10—Indiana.....	18,661,281

Washington was the only one of the ten leading States in 1919 showing a decrease in production under 1918. However, it was able to hold second place. Indiana dropped from tenth place in 1918 to fifteenth place in 1919. Wisconsin produced nearly 32 per cent. of the total, or more than the combined output of Washington, Michigan and Illinois.

Modified Evaporated Milk

As a matter of more than passing interest it should be noted that evaporated milk, part or full skimmed, modified with foreign fat or vegetable oils, has been used in increasing quantities as a substitute for true evaporated milk for home consumption. While but 12,000 pounds were tinned in 1916, more than 62,000,000 pounds of the case goods were manufactured in 1919, as shown by the following table. In 1916, the production of the substitute compared with the production of true evaporated milk, case goods, was negligible, while the production had increased to over 5 per cent. by the close of 1919.

PRODUCTION (IN POUNDS) OF EVAPORATED MILK (PART OR FULL SKIMMED) MODIFIED WITH FOREIGN FAT IN THE UNITED STATES, 1916-1919.

Year.	Case.	Bulk.	Total	Increase over previous year. Per cent.
1916.....	12,000	14,134,712	14,146,712	
1917.....	18,504	17,487,064	17,505,568	24
1918.....	41,033,855	7,591,182	48,625,037	178
1919.....	62,262,221	2,748,120	65,010,341	34

Hercules Powder Co. Will Recover Commercially Naval Stores from Waste Pine Timber

At the conclusion of hostilities the Hercules Powder Co. began active search for promising commercial fields in which to utilize the technical capacity developed in its war-created organization. It is to the credit of the company's sales department that the suggestion of its representative was the first made and the first adopted by the industrial research department. Mr. W. R. James made this first suggestion and in the April issue of Chemical Age he described the experimental work of the Hercules Powder Co. in the determination of the commercial possibilities latent in the utilization of the waste timber of the cut-over pine lands of the South.

J. S. Shaw, C. C. Hoopes, J. P. McLean and M. M. Hunter carried on the original investigations which, on confirmation by N. P. Rood and L. N. Bent, formed the basis of the company's decision to engage in the naval stores industry.

Increasing demand and inadequate production of turpentine and rosin, with consequent soaring prices, the growing need of land for agricultural purposes whose value had been taken off by the naval stores' operator and the lumber mill, the rosin values left in

the stumps and the need of explosives to eject them from the soil, all joined to encourage the adoption of Mr. James' suggestion, which, in its economic ramifications, means a great deal more to southern progress than it does to the Hercules Powder Co.

The first naval stores plant will be established at Hattiesburg, Miss., where a 100-acre tract for a site has been acquired, and a railroad switch already built. The plant, with a daily capacity of 100 tons of stumps and lightwood, involves an investment of \$500,000, and has been designed and will be built by A. D. Little, Inc., with Chief Engineer E. C. de Coriolis and W. A. Smyth, engineer, on the ground.

N. P. Rood, vice-president of the Hercules Powder Co. and manager of the industrial research department, is chief executive of the enterprise. C. A. Lambert will be superintendent in charge of plant which will be in operation before the end of the year. Mr. Rood, by contract with the Newman Lumber Co., of Scranton, Pa., which owns 7,500 acres of cut-over land within 35 miles of the plant and accessible by railroad, has provided sufficient raw material for indefinitely prolonged operation.

Growth in the Storage Battery Industry

The Philadelphia Storage Battery Co., Ontario and C streets, Philadelphia, Pa., has awarded contract to Stewart Brothers Co., of that city, for a two-story brick addition, to cost about \$40,000.

The Evans Storage Battery Co., Camden, N. J., has been incorporated at \$250,000 by Frank S. Muzzey, Joseph P. Murray and F. Stanley Saurman, to manufacture storage batteries.

The Victory Storage Battery Co., Maryland Casualty Building, Baltimore, Md., has been incorporated with a capital of \$310,000 by A. J. Thompson, Edward B. Masterton and Henry Stockbridge to manufacture storage batteries.

The Palisade Storage Battery Co., Englewood, N. J., has been incorporated with a capital stock of \$25,000 by J. R. and B. M. Birsh and C. W. Headden, Yonkers, N. Y., to manufacture storage batteries, etc.

The Westinghouse Union Battery Co., Pittsburgh, recently organized by the Westinghouse interests, will manufacture storage batteries for all branches of industry. It is now occupying a portion of the works of the Union Switch & Signal Co., Swissvale, Pa., and is giving employment to about 500 men. Tentative plans include a new plant on a neighboring site to provide a daily capacity of 3,000 batteries. A. L. Humphrey, president Westinghouse Air Brake Co., is chairman of the board of directors; T. R. Cook, formerly chief engineer and production manager for the Willard Storage Battery Co., Cleveland, is vice-president and general manager.

The Standard Battery Mfg. Co., Fort Worth, Tex., manufacturer of electric batteries, is planning for the erection of a reinforced concrete addition to its plant to double the present output. Albert Kramer is president.

The O. K. Giant Battery Co., Gary, Ind., is receiving bids through Z. Erol Smith, 305 East Fifty-fifth street, Chicago, on an 11-unit plant, to cost \$660,000.

Savannah Section—American Chemical Society

By a waiver of jurisdiction from the Georgia Section of the American Chemical Society, as required by the action of the council of the society on April 12 at St. Louis, Mo., a charter was granted on May 10 to a new section to be known as the Savannah Section and embracing the counties of Chatham, Effingham, Bryan, Liberty, Wayne, McIntosh, Glynn and Camden, Ga.

On May 27 the section was organized and the following officers were elected to serve for the balance of the year: President, J. J. McManus; vice-president, Maurice Siegel; secretary-treasurer, Herbert P. Strack; counselor, F. N. Smalley.

Brunner Mond & Co., Ltd., have acquired the British government nitrate plant at Billingham-on-Tees, England. The government plan to engage in nitrogen fixation didn't progress further than the purchase of site and the ordering of considerable material. The buyers will develop the Haber process and are now engaged in designing a commercial plant and preparing for its construction. The capital invested will aggregate \$25,000,000.

Governmental Encouragement to Discovery of a Gasoline Substitute

Appropriation of \$250,000 for the use of the Bureau of Chemistry in the discovery of a substitute for gasoline is called for in a bill introduced in the House by Representative Harold Knutson of Minnesota.

"In view of the threatened shortage of gasoline," said Mr. Knutson, "I have been moved to prepare and introduce the resolution which follows below. In the three years that I have been in Congress I have given this subject considerable study. My first plan was to take off all restrictions on the manufacture of denatured alcohol, but it was thought by many members of Congress that this would result in a large number of illicit stills springing up over the country, and in deference to their views I have temporarily given up that plan for the one now called to your attention. This resolution I have introduced in the House.

Text of Bill

"Whereas, gasoline is a commodity of universal use and is indispensable in the agricultural and commercial progress of modern civilization, and the paramount importance of a sufficient supply of gasoline, or a suitable substitute therefor to supply the needs of the American people is a self-evident proposition; and

"Whereas, the reserve and visible supply of gasoline is being rapidly exhausted by the growing demand, and the price of which is being advanced to unprecedented levels; and

"Whereas, the existing scarcity of gasoline and its threatened total exhaustion in the United States has become a matter of such grave concern to the agricultural and commercial interests of the country that it becomes absolutely imperative that a substitute therefor be found: Therefore be it

"Resolved by the Senate and House of Representatives of the United States of America in congress assembled, that the sum of \$250,000 be and is hereby appropriated to be used by the Bureau of Chemistry, Department of Agriculture, in discovering a suitable substitute for gasoline."

Swiss-American Dyestuffs Consolidation

In appreciation of the fact that the United States comprise the richest markets for and the most abundant source of raw materials of dyestuffs manufacture, a syndicate representing the three principal dye works of Basle, Switzerland, will organize an American corporation whose interests will embrace the dyestuffs manufacturing activities of Ault & Wiborg Co., of Cincinnati, Ohio.

Mr. L. A. Ault, president of the latter company, announces the participation of his organization in the new corporation, which, while he will be a member of the board of directors, will be managed by the Swiss interests which will take possession of the American plant on July 1. Mr. Ault stipulated that "not one mill of German money, directly or indirectly, remotely or otherwise, would or could be used at any time, either in the acquisition or the expansion of the industry."

The Swiss interests comprise the Society of Chemical Industry, represented in the United States by A. Klipstein & Co., 654 Greenwich street, New York; Sandoz Chemical Works, with offices at 1133 Broadway, New York, and J. R. Geigy, with offices at 89 Barclay street, New York, under the name of Geigy Co., Inc.

Pooling of Technical Information by English and American Dye Makers

The consolidation of Swiss and American dye manufacturing interests represented by the purchase of the dyestuffs department of the Ault and Wiborg Co. by Basle, Switzerland, dye makers, directs attention to the recent rabid denunciation for political purposes by Senator Thomas of Colorado of the business agreement between E. I. du Pont De Nemours & Co. and the Levinstein Company, Ltd., of Manchester, England, for the interchange of technical information. Senator Wolcott of Delaware on June 3 in the Senate defended this arrangement to give to the American consumers all the advantages secured to the British consumer through the seizure of the German plants.

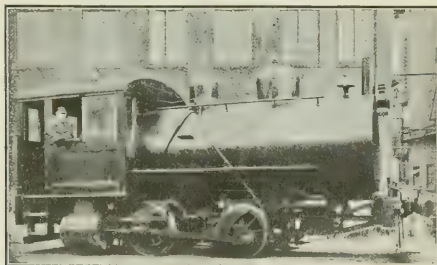
"The immediate effect of these negotiations," he said, "was to secure for America the 'know-how' so urgently needed in this country and which enabled the du Pont Company in a comparatively short time to reproduce and make available to American consumers substantial quantities of dyes equal in quality to any manufactured by the Germans. If my view of this contract is correct it cannot be fairly said that any monopolistic or otherwise improper motive underlies either negotiations or execution."

Kodak Park's Fireless Locomotive

A unique addition to methods of transportation employed in chemical plants is found in the use of a novel type of locomotive at the Kodak Park Works of the Eastman Kodak Co., Rochester, N. Y.

The size of this plant may be surmised from the fact that it has its own standard gauge railroad, its own freight cars for intra-plant transportation of material, and its own locomotive. In the illustration, for which we are indebted to "The Kodak Magazine," is shown a new type of locomotive, whose daily duty is the handling of 30 to 40 carloads of material.

The motive power is steam, provided originally by



The Fireless Locomotive.

the plant power house, and then produced independently in the following manner: The boiler is filled four-fifths full of water, after which steam is admitted by means of a detachable pipe until a pressure of 125 lbs. is indicated. At this pressure saturated steam has a temperature of 353 degrees Fahrenheit. With the reduced pressure consequent upon the use of the steam in performing work, steam continues to be formed as the boiling point of water at atmospheric pressure is approached. The locomotive can be operated at as low a pressure as 20 lbs.; at 15 lbs. pressure this tractor is able to return to the power plant for a fresh

addition of heat. Recently a train of 80 freight cars, two-thirds of a mile long, was handled by this engine. At 60 pounds pressure the pulling power is 14,530 pounds.

Danger from sparks and disfiguration by smoke and soot are eliminated. George Spencer, the engineer, to provide the verisimilitude of the ordinary locomotive, attached a section of stove pipe to the boiler.

A larger locomotive of the same type is now being specially built for the Eastman Co. at the Baldwin Locomotive Works. Its tank will hold a pressure of 200 pounds, and its weight will be 128,000 pounds. It will have a pulling power of 25,660 pounds.

American Oil Chemists' Society

At the eleventh annual convention of the Society of Cotton Products' Analysts, held May 10 and 11 at New Orleans, the technical expansion of the cotton oil millers' and refiners' activities was recognized in the change of the name of the organization to that of American Oil Chemists' Society.

The adaptation of the cotton oil millers' and refiners' equipment to the treatment of soya bean, peanut and copra has been demonstrated in the enlargement of the industry in the handling of these commodities.

The society adopted regulations that only chemists certified by the society should receive recognition by arbitration committees of the Inter-state Cottonseed Crushers' Association. The membership embraces over 200 chemists engaged in the glyceride oil industries.

The following officers were elected: F. B. Porter, Fort Worth Laboratories, president; C. B. Cluff, American Cotton Oil Co., vice-president, and Thos. B. Caldwell of Law & Co., Atlanta, secretary and treasurer.

Industrial Notes

The Mineral Products Corporation, Newark, N. J., has been incorporated with a capital stock of \$100,000 by George W. Frelich, George H. Winkler and Howard F. Kirk, to operate a metal reclaiming plant.

* * *

The United States Rubber Co. will erect a new plant at Hartford, Conn., for its subsidiary organization, the Hartford Rubber Works, specializing in the manufacture of automobile tires. It will cost \$3,000,000, including equipment. An electric power plant, to cost \$264,000, will also be erected, as well as a building for employees to cost \$402,500.

* * *

The Rollin Chemical Co. is rebuilding at a cost of \$150,000 the monochlor division of its Charleston plant, which was recently burned.

The construction by Wilson & Co., packers, of a \$100,000 oleomargarine plant at Los Angeles, Cal., represents that balancing of economic forces that determines the migration and location of industries. The ascending of coconut oil as a raw material for artificial butter is a notable development in the edible oil trade.

* * *

The Virginia Smelting Co., with offices in Boston, Mass., and works at West Norfolk, Va., has been enlarging its plant for the production of liquid sulphur dioxide, and expects shortly to be producing 10,000 pounds a day. The product is being used by the cotton mills for the manufacture of hydrosulphite of soda and by manufacturing chemists. Chas. F. Garrigues Co., 54 Wall street, New York, are the sales agents.

Rare Earths and Incandescent Gas Mantle Industry

By the United States Tariff Commission

The incandescent gas mantle has developed from the research of the Austrian chemist, Dr. Karl Auer von Welsbach. About 1880 he began his study of the rare-earth elements and attempted to utilize the property of thorium oxide and other rare earths of emitting an intense white light when heated in a Bunsen flame. In 1884 he patented the use, as a lighting medium, of a fibrous network composed of the oxides of certain of the rare-earth metals.

It was not until about 1893, however, that Welsbach discovered that the maximum luminosity was produced by a mantle composed of 98-99 per cent. of thoria and $\frac{1}{2}$ per cent. of ceria. The commercial use of the incandescent gas mantle may be said to have begun with this discovery, and when a few years later the large deposits of the raw material, monazite, were found, the commercial success was assured. A rapid spread of lighting by incandescent gas burners followed and the gas mantle has, in a way, saved the gas-lighting industry from the extremely severe competition of the electric light. The incandescent gas mantle gives the cheapest illumination wherever natural or manufactured gas is available. About 1900, the inverted mantle was invented. This form throws the light downward instead of upward and avoids a shadow, so that it is an important advance in the industry.

The world's consumption of gas mantles according to Kithil's estimate in 1915 amounted to about 300,000,000 mantles each year. V. B. Lewis, an English authority, gives the following estimate of the prewar consumption (1912):

	Mantles.		Mantles.
Germany	100,000,000	Belgium	3,500,000
America	60,000,000	Italy	3,000,000
England	38,000,000	Russia	1,500,000
France	16,000,000		

The war to some extent indirectly caused an increased use of gas mantles. The demand for toluol for the manufacture of the important explosive, T. N. T., was so great and the supplies so much below the estimated requirement, that every possible means of increasing the supply had to be exploited. Much toluol could be obtained by removing it from illuminating gas, and plants for its recovery from this source were installed in many large cities. These "stripping" plants, as they are called, seriously damage the lightgiving power of gas when used in open-flame burners, but do not materially decrease the value of the gas for use with incandescent gas mantles or for cooking or heating purposes. This recovery of toluol for military uses indirectly stimulated the demand for mantles.

Method of Manufacture.

The fabrics used in the manufacture of mantles are cotton, ramie, and artificial silk. Ramie fibre gives the best quality, but is more expensive than cotton fabric, and the greatest number of mantles in this country are probably made from cotton. It is said that in Europe, before the war, 90 per cent. of the mantles were made from ramie. The use of artificial silk is a more recent practice, and very satisfactory results are obtained. Its ash is claimed to have a greater elasticity and there is the additional advantage that it does not require washing before impregnation.

The fibre is woven into the form of a hose or tube, bleached in an acid or alkaline bath and very thoroughly washed in distilled water in order to decrease the quantity of mineral matter and to remove grease and other foreign substances.

After drying in a current of hot air, the fabric is then treated with the "lighting fluid," which is a solution containing from 25 to 50 per cent. of thorium and cerium nitrates in the proportion of about 99 parts of thorium nitrate to one part of cerium nitrate. Small quantities of beryllium nitrate and magnesium nitrate are also added to the fluid in order to strengthen the ash skeleton. The fabric is then cut into suitable lengths and one end closed and sewed with asbestos thread, which afterwards forms the support for the mantle.

The next step which is known as the "fixing" process, consists in strengthening the parts of the mantle which are to be subjected to the greatest strain. This is accomplished by treating these portions with a thorium solution containing a considerable proportion of alumina and the alkaline earths. If desired, the mantle may then be branded with the manufacturer's trade-mark by the use of a mixture containing didymium nitrate, which is a by-product in the manufacture of cerium nitrate. After the fabric is dried and shaped it is "burned off" and the nitrates converted into the oxides by an intense flame. This operation requires considerable skill and 2 or 3 per cent. of the total number of upright mantles are usually damaged in the process. In the case of the inverted mantle the loss may run as high as 10 to 20 per cent. This gives rise to the material known as *gas-mantle scrap* which is saved and returned to the thorium-nitrate manufacturer for the recovery of the thoria and ceria. Practically 90 per cent. of the gas-mantle scrap is obtained in this way and the remainder consists of worn-out mantles collected from the gas companies and other large consumers. The mantles which are not damaged in the heating process and have passed inspection for size, shape, and material defects, are dipped into a solution of collodion, in order to give them the necessary strength to withstand the shocks of shipping.

This description refers chiefly to the cotton or ramie mantles. The types used for lighting railway cars and all artificial silk mantles require different methods of manufacture, although the same general principles are involved.

The number of mantles manufactured from a pound of thorium nitrate varies with the shape, quality and size of the product. Johnstone states that in English practice 500 to 600 of the best quality upright mantles of the "C" size are made from a kilo (225 to 275 mantles per pound), and 1,000 per kilo of the cheaper quality (450 per pound). In American practice the number of mantles per pound of thorium nitrate averages about 325.

Mineral Raw Material of the Gas Mantle.

The fundamental raw material is the mineral monazite, which is usually mined in the form of an alluvial sand, and consists chiefly of the phosphates of cerium and other rare earth metals mixed with small and variable amounts of thoria. It varies in color from yellow to brownish red or even black, and has a specific gravity of 4.7 to 5.2. Monazite usually contains about

30 per cent. of ceria and from 4 to 12 per cent. of thorium. Since the gas mantle requires 99 per cent. of thorium to 1 per cent. of ceria and since the other uses do not utilize all of the ceria produced, the value of the monazite depends primarily upon its contents of thorium.

A typical analysis of the Brazilian sand shows the following content:

	Per cent.		Per cent.
Thorium	5	Yttrium oxide.....	2
Ceria	30	Iron oxide and calcium	
Lanthanum oxide.....	14	oxide	5
Neodymium oxide and		Phosphoric anhydrid...	28
prasesodymium oxide	16		

Development of the Industry.

At the time of the invention of the gas mantle the principal sources of thorium were the minerals, thorite and thorianite, obtained in small quantities from Sweden and Norway. The search for other supplies resulted in the discovery of large deposits of monazite sand on certain sea beaches in Brazil. Early control of these deposits was secured by an American, John Gordon, who had obtained from the Brazilian Government a monopoly of the important deposits in the State of Bahia. In 1902, by an exclusive agreement with Gordon, the supply of monazite came into the hands of a close combination of the four largest German manufacturers and the single large Austrian producer of thorium nitrate. By this agreement Gordon was to receive \$150 per metric ton for the monazite and an additional percentage based on the profits from the thorium and cerium nitrates. The combination of thorium manufacturers, thus fortified by the control of the raw material, raised its price of thorium nitrate by 100 per cent.

In a short time, however, the Brazilian Government recognized the value of the monazite resources and granted a lease for the exploitation of the coast lands in the State of Espirito Santo. The German thorium combination, realizing the possible competition of this new source, immediately concluded a second contract by which half of their supply was obtained from Gordon, and half from the De Freitas Co., of Hamburg, who had secured this new lease from the Brazilian Government.

Other manufacturers of thorium nitrate in Germany and in various other countries were making every effort to find new sources of monazite in order to break the German monopoly. Small deposits were located and worked in North and South Carolina; in fact, the higher price of thorium nitrate made it possible for one German manufacturer, who was not a member of the combination, to import Carolina monazite into Germany. The Carolina deposits were also supplying the important American manufacturer, and for a short time monazite mining proved very profitable in this country. However, the market for thorium nitrate was gradually broken, and with the discovery of richer deposits of monazite sand in India, the Carolina mines were unable to compete with the Brazilian and Indian producers, notwithstanding a duty of 4 cents per pound under the act of 1909 and 25 per cent. ad valorem under the act of 1913. At the present time there is no commercial production of monazite in the United States.

Nature of the Deposits.

Brazil.—The most important deposits are those lying along the seashore, particularly in the States of Bahia and Espirito Santo. These sands result from the weathering of the monazite-containing rocks and have been concentrated by the natural action of the tides. When first exploited, the sand was sufficiently

valuable to be exported in crude form, but in later years the material has been of a lower grade and some preliminary concentration has been necessary. This concentration is accomplished on jig tables by a wet method, by which the monazite sand, being heavier, is separated from the gangue. The coast lands which are claimed by the Federal Government, are known as "marinhas" and have been defined as extending 33 meters inland from the mean high-water mark. The lands lying immediately behind the marinhas are the possession of the States or of private individuals and they contain valuable deposits which could be worked profitably if it were not for the uncertainty in the marinhas boundaries. There are other deposits in the interior but the proportion of monazite in the gravel is much smaller and the expense of transportation has not permitted their exploitation.

India.—Deposits of monazite sand especially rich in thorium were discovered in 1909 along the seacoast of Travancore in Southern India. In the report of the State geologist (1917) the Travancore deposits were estimated to cover an area of 1,427 acres, capable of yielding approximately 1,776,000 tons of monazite. Later surveys, however, indicate that this estimate is much too conservative.

India produced approximately three-fourths of the world's output of monazite in 1915 and because of the higher percentage of thorium, 90 per cent. of the total thorium production. The deposits soon after their discovery became the concession of a firm who sold the entire output to Germany. At the outbreak of the war, however, the German interests were eliminated and the control taken over by British subjects who are under contract to sell monazite to British firms at any time and at a fair price.

North and South Carolina.—The deposits of monazite sand in the Carolinas are very scattered and no single deposit has been found which is large enough to justify the erection of a large-scale concentrating plant. The percentage of monazite in the gravel averages but about one-fourth of 1 per cent. At the time the deposits were being worked the mining was carried on by methods similar to those used in the old placer method of mining gold and usually by the natives and at times when no farm work could be done. Mr. Kithil of the Bureau of Mines estimated in 1915 that the cost of producing 1 ton of 92-95 per cent. monazite from the Carolina deposits was \$169 at the concentrating plant. Although there is still an abundance of monazite in the United States, the deposits can not be worked in competition with the foreign sand.

Other Sources of Thorium and Cerium.

There are certain other minerals such as thorianite and thorite which contain a much larger percentage of thorium but are comparatively rare and do not compete with monazite as a source of thorium. Thorianite is a heavy black mineral containing 60 to 70 per cent. of thorium and 15 to 30 per cent. of uranium oxide. It is found in certain stream beds and gem-bearing sands in Ceylon. About 9 tons were exported from Ceylon in 1905, but since then only small quantities have been produced. It is known, however, that British firms are again offering thorianite and are claiming a special value because of its content of uranium and radio-active substances. Thorite is a yellow to dark brown mineral consisting essentially of thorium silicate. It is of little importance although occasionally exported from Norway and Ceylon. Allanite and cerite are cerium-bearing minerals which were formerly regarded as commercial sources of the metal,

cerium. Since, however, more cerium salts are obtained as by-products from monazite than can be consumed, allanite and cerite are of negligible industrial importance.

Thorium and Cerium Nitrates.

Thorium nitrate is a white crystalline material, very soluble in water or alcohol and should be thoroughly purified if intended for use in mantle manufacture. The presence of phosphates causes the mantles to be excessively brittle and not more than 0.004 per cent. of P_2O_5 is usually permitted. The alkalis and alkaline earths cause the mantles to shrink and lose their shape and the presence of certain rare-earth metals decreases their luminosity.

By far the most important use for thorium nitrate is in the manufacture of incandescent gas mantles; thorium nitrate with about 1 per cent. of cerium nitrate constitutes the impregnating fluid used for all types of mantles. A small amount of thorium is sometimes alloyed with tungsten to be used as a filament for incandescent electric lights, and certain flash-light powders also contain thorium. Small pastilles consisting of 99 per cent. of thorium and 1 per cent. of ceria give off an intense white light when heated in a gas flame and are used for motion-picture projection in localities where the electric arc is not available.

Cerium nitrate is a white crystalline salt which is very deliquescent and decomposes if heated to 200° C. If it is to be used in the manufacture of mantles it should be of purity comparable to that required for thorium nitrate.

The principal use for cerium nitrate is in gas-mantle manufacture. Cerium metal forms the basis of the manufacture of pyrophoric alloys. Other salts of cerium are used in the manufacture of flaming electric-arc lamps, in glass making and ceramics, in tanning and dyeing, and in medicine.

Method of Manufacture.

The preparation of pure thorium and cerium nitrates is a long and complex process, and there is no recognized procedure used by all manufacturers. The general principles involved are well known, but certain of the details of the final stages in the purification are guarded as trade secrets.

The first step in the process is known as "breaking" the monazite sand and consists in heating the finely ground sand with slightly more than its weight of sulphuric acid. This changes the phosphates to sulphates and yields a white, pasty mass which is poured into water and left to settle. The insoluble residue is filtered off, and the solution, consisting of the sulphates of thorium, cerium, lanthanum, etc., in dilute phosphoric and sulphuric acids, is partially neutralized with an alkali or alkaline earth. This causes the precipitation of a much enriched thorium phosphate, and by filtering, a large proportion of the other rare earths is removed. This filtrate contains the cerium which is separated from the salts of other similar elements by another series of operations. The thorium-phosphate precipitate is usually redissolved in a small quantity of acid and the process repeated. In the older practice the phosphate was next treated with oxalic acid and the thorium precipitated as thorium oxalate. In the more recent processes, however, the phosphate is cooked with soda ash, which converts it to an insoluble basic carbonate, and this, on further treatment with caustic soda, yields thorium hydroxide. The hydroxide is dissolved in sulphuric acid and the thorium sulphate fractionally crystallized, a process which removes most of the more soluble

cerium sulphate. The sulphate is reconverted to the hydroxide with ammonia and the thorium nitrate finally obtained by dissolving in pure nitric acid and crystallizing. The process is said to yield at least 90 per cent. of the thorium contained in the monazite sand.

The Industry in the United States.

Until the outbreak of the European war, the Welsbach Co., of Gloucester City, N. J., was the principal producer of thorium and cerium nitrates from monazite sand in the United States. There were at least two other producers, but the output of these firms was much smaller than that of the Welsbach Co., who before the war consumed a large proportion of their output in the manufacture of mantles. The other manufacturers of gas mantles (about 30 in number) relied on imported thorium and cerium nitrates.

When the European war broke out English and French mantle makers, who had largely relied on German and Austrian sources of thorium nitrate, were cut off from these sources of supply and immediately turned to the American producers. The companies in the United States expanded their productive capacity to meet this foreign demand and the shortage caused in this country by the decreased imports of thorium nitrate. The Lindsay Light Co., of Chicago, took up the manufacture on a considerable scale in 1914. Other producers are the Maywood Chemical Works, of Maywood, N. J.; the Block Light Co., of Youngstown, Ohio; and the General Gas Mantle Co., of Camden, N. J. The Standard Tungsten Corporation, of New York, and the New Process Gas Mantle Co., of Philadelphia, formerly manufactured some thorium nitrate.

Pyrophoric Alloys.

Auer von Welsbach, in his research on the rare-earth metals, discovered in 1903 that certain of the alloys when scratched with a file gave off sparks capable of igniting inflammable gas. Later discoveries and improvements have demonstrated that an alloy of the cerium metals with iron possesses the maximum pyrophoric properties. This alloy, known as pyrophoric alloy, cerium-iron alloy, spark-giving alloy, Auer metal, etc., is used in automatic gas-lighting devices and in many types of pocket cigar lighters. In the latter the sparks fall upon a cotton wick containing niter or saturated with an inflammable liquid, such as alcohol, benzol, or gasoline. There was some demand for pyrophoric alloys for war purposes in star shells, tracer bullets in which the friction of the air during the flight causes the alloy to burst into flame, and in automatic lighters for use in trenches and other places where matches proved impracticable.

The pyrophoric alloys may be made either from metallic cerium or from a mixture of the cerium-earth metals in approximately the following proportions: Cerium, 50 to 75 per cent.; lanthanum, neodymium, and praeosdymium, 25 to 45 per cent.; and iron 0.5 to 1 per cent.

The manufacture of pyrophoric alloys employs the rare-earth residues obtained as a by-product from monazite sand and first converts them to the anhydrous chlorides. The complete dehydration, which is a rather difficult process, is essential in the preparation of the material for the subsequent steps in its manufacture. The fused chlorides of the rare-earth metals are next electrolyzed in a graphite cell using a large iron cathode.

Before the war the pyrophoric alloy manufactured in this country was made from metallic cerium imported from Germany. Soon after the imports were

cut off by the war, the manufacture of metallic cerium was undertaken by the New Process Metals Co. of New York. This company was, however, unable to make the pyrophoric alloy with iron owing to a patent controlled by the Austrian manufacturers and the company, therefore, sold their product to the American agent of the Austrian producers. Under the trading with the enemy act in 1917, the New Process Metals Co. was able to secure a license from the Federal Trade Commission and manufactured pyrophoric alloy under the patents formerly controlled by the Austrian manufacturers. Pyrophoric alloy has been quoted at \$25 to \$40 per pound depending upon its quality and the degree of manufacture. Misch-metal sells for about \$10 per pound.

Mesothorium.

Mesothorium is a radioactive substance obtained from monazite sand as a by-product in the manufacture of thorium nitrate. The chemical properties of mesothorium are identical with those of radium and if the two are mixed intimately it is impossible to separate them. Mesothorium has the same use as

radium in therapy and it is probable that its manufacture will increase largely in the future.

If it is intended to recover mesothorium from monazite, a small quantity of barium chloride is added during the sulphuric-acid treatment of the ore, and the mesothorium is removed with the insoluble barium sulphate. It is recovered from this precipitate and purified by a series of fractional crystallizations as the chloride and bromide.

Only a small quantity of mesothorium has been recovered in this country up to the present time, but at least two manufacturers are producing it as a by-product of the manufacture of thorium nitrate for gas mantles. The supply of mesothorium, however, will never be very great for, according to Kithil, only 2.5 milligrams of mesothorium are obtained from a metric ton of monazite—the ratio of mesothorium to thorium being about 1 to 19,000,000. The preparations of mesothorium are usually marketed in the form of the chloride. The price, depending upon the purity of the product, is from \$45 to \$75 per milligram or roughly about \$2,000,000 an ounce.

Crimson Antimony

Its Use in Rubber Compounding and Methods of Manufacture

By John M. Bierter

Technical Superintendent, Boston Woven Hose and Rubber Co.

Crimson antimony has been the most generally satisfactory red pigment used in coloring rubber compounds. It has good coloring power, is fairly stable, especially in press cures. In open cures, however, everyone using this pigment has experienced difficulties on account of its tendency to change from the unstable oxysulphide to the stable black sulphide. This reaction takes place at times, only to a slight extent, however, but sufficiently to ruin the value of crimson antimony as a coloring ingredient. The reaction is most pronounced on the surface of the rubber compound where it comes in direct contact with live steam.

We all have tried to discover the cause of this reaction; we all probably would disagree as to its cause; and have probably changed our minds on this point a number of times. There is such a variety of possibilities that may cause this change that many explanations are possible. If crimson antimony is not manufactured under proper conditions, it will not cure satisfactorily in open steam, and, so far as we know, there is no known chemical test that will detect the difficulties except trial. The presence of too great a quantity of alkaline substances in a rubber compound always will cause trouble; sulphurous acid when present to the extent of 0.2 of one per cent. will cause trouble and is positive proof that the crimson antimony has not been properly made. Any crimson antimony will darken if vulcanized in open steam at an excessive temperature. A temperature corresponding to 50 pounds steam pressure, we believe, is the limit.

Prior to 1914 there was no satisfactory crimson antimony made in this country of which we knew. From our experience at least 10 per cent. of that imported was not satisfactory for open steam cures. At the outbreak of the war we realized that it was necessary to find a substitute for crimson antimony, or manufacture it ourselves. The manufacture of

crimson antimony, as outlined in the literature, led us to believe that it was easier to manufacture this pigment than to find a substitute. We started to develop a method of manufacturing this pigment by these methods, but we early learned that while the methods outlined in the literature might be satisfactory for manufacturing crimson antimony for calico printing, they were far from giving a product that would vulcanize in open steam even under ten pounds steam pressure. After several months work in this direction, we endeavored to find a substitute, as our supply of crimson antimony was rapidly being depleted. We had little success in finding a substitute, so we continued our efforts to manufacture a satisfactory product.

The manufacture of crimson antimony, like the manufacture of many other chemical substances, can frequently be carried out in laboratory batches and give satisfaction, but when the same method is tried on a commercial scale it will not be successful. We have developed processes which on a small scale apparently were going to be satisfactory, but on trial in large batches they invariably would darken, the cause of this darkening not always being apparent. We began by trying to obtain antimony trichloride by treating the metal, oxide and sulphide of antimony with hydrochloric acid, but we were unable to obtain uniformly good results. We eventually discovered that we were not obtaining pure antimony trichloride and that unless this be done a satisfactory crimson antimony cannot be obtained.

If antimony trichloride made by the above methods be distilled, it will invariably be found that water and hydrochloric acid will come from the still, then antimony trichloride; but before the distillation is finished the material in the flask will change in appearance and the distillation will leave a large amount of antimony tri-oxide. This small amount of antimony oxide,

when boiled with sodium thiosulphate does not change to oxysulphide, but to antimony trisulphide. We next tried making antimony trichloride by treating antimony metal with sulphur chloride, the action taking place in an iron retort, and then distilling the antimony trichloride. This gave a distilled antimony trichloride from which we are able to make satisfactory crimson antimony, but the reaction was so violent that it was difficult to control, and the retort shortlived. We were at a loss to find a retort which for any great time would withstand the action of antimony trichloride at the temperature at which this reaction takes place.

Graphite retorts were tried. These were quite satisfactory for a few distillations, but the walls of the retort soon absorbed so much antimony trichloride that they invariably would break when the third or fourth distillations were attempted. Stoneware retorts would probably have been quite satisfactory, but we changed our method before making a trial.

We next made antimony trichloride by passing chlorine over metallic antimony in a water-cooled receptacle from which the antimony trichloride was siphoned from the bottom. To this we added sufficient water to prevent crystallization. Antimony trichloride with one molecule of water is a definite chemical compound and fairly stable, and there is no tendency for this to change to antimony tri-oxide. This material, when added to an excess of water, is completely precipitated as antimony oxychloride, which is the most satisfactory substance to convert to oxysulphide with sodium thiosulphate. If the precipitation is then carried out properly crimson antimony will result, which will cure satisfactorily.

The following procedure will give satisfaction on a commercial scale.

To 135 pounds of antimony trichloride we add 15 pounds of water to keep it in a liquid and stable form. This is poured into a large tank containing about 60 cubic feet of water, where it is slightly mixed with wooden paddles and completely converted to antimony oxychloride. At this point we add 21 pounds of whiting to reduce the acid concentration so that the formation of antimony oxysulphide is not hindered when the thiosulphate is later added. This step in the procedure is exceedingly important, for if the reaction is attempted at too high an acid concentration side reactions take place. Four hundred and eighty pounds of commercial sodium thiosulphate are now poured into the tank, and the whole immediately agitated with four steam jets. The steam serves a double purpose; it both agitates and heats the solution. The heating is continued for approximately ten minutes, or until the desired color is obtained. The steam then is shut off and approximately 250 cubic feet of water quickly run into the tank to stop the reaction. The time of heating depends upon local conditions.

The material is now allowed to settle and is washed three times by decantation. It is then washed free of sulphurous acid in a filter press and dried at a low temperature.

We have been manufacturing continuously crimson antimony by this method since the spring of 1915. During that time have had only 250 pounds of unsatisfactory material, and this was due to carelessness.

C. Wilbur Miller, president of the Davison Chemical Co., of Baltimore, Md., will attend the International Trade Council in Paris this month as the representative of the Manufacturing Chemists' Association and the National Fertilizer Association.

Sulphuric Acid Production of the Little Rock-Picron Industrial Co.

Sulphuric acid manufacture is a basic industry without which our national industrial system could not function. It far surpasses nitrogen fixation in present economic importance. That it does not possess the research enticements and commercial possibilities peculiar to the latter art doubtless partly is responsible for the War Department's satisfaction to let private enterprise have at a tithe of its cost its picric acid plant built at Picron, near Little Rock, Ark., by the Everly M. Davis Chemical Corp., 480 Lexington avenue, New York, during the war.

Everly M. Davis, 61 Broadway, N. Y., and H. C. Couch, president of the Arkansas Night Acid Power Co., Little Rock, Ark., head the interests, organized as the Little Rock-Picron Industrial Co., which bought the plant from the government and which have been active in the establishment of an industrial center at Picron.

The sulphuric acid department consists of two chamber sets with a monthly capacity of 9,000 tons of 60° acid, with a concentration capacity to handle one-half of this quantity.

Arrangements have been completed for the operation of one chamber set with incidental equipment for the production of 60° acid for acid phosphate manufacture, and 66° acid for petroleum refining.

The consumption of sulphuric acid has enormously increased since 1913. Estimates for 1919 show a production of 5,500,000 short tons, as against 3,013,509 tons in 1913. The pre-war consumption of this material averaged 3,250,000 tons, but this has also considerably increased since that time, and now is estimated at 4,500,000 short tons.

The Steel Co. of Canada, Ltd., closely affiliated with the United States Steel Corporation, is installing a benzol plant in connection with the coke ovens at its plant at Hamilton, Ont. Production is expected to commence in September. It is expected that 100,000 gallons of motor fuel per month will be the production. At present a shortage of coke is interfering with the company's operations.

The Nitro Products Co., formerly of Saginaw, Mich., where its plant, on April 15, was destroyed by fire, has purchased from the Charleston Industrial Corp. a site, with buildings, for a new plant at Nitro, W. Va. The buildings, 21 in number, comprise pulping houses, acid storage tanks, acid weigh house, absorbing house, denitrating house and an emergency hospital. The company's products embrace aniline dyes and artificial filaments from cellulose.

William Hiergesell & Sons, dealers in chemical glassware, hydrometers, thermometers, etc., formerly at 111 Nassau street, New York City, now occupy the five-story building at 295 Pearl street, a change necessitated by the growth of the business. Ample quarters now permit larger stocks and their prompt delivery incident thereto.

The Union Sulphur Co. is the owner of a new sulphur freighter of 7,000 tons carrying capacity launched on June 5 by the Newburgh Shipyards, Inc., at Newburgh, N. Y. The vessel, christened "Herman Frasch," is 371 feet in length and 51 feet in width, with many improved features of marine engineering.

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A Consolidation of
The Chemical Engineer
and Chemical Age



WITHIN the fortnight the Canadian Manufacturers' Association (4,000 members), the National Press Association (600 members), the American Federation of Labor (4,000,000 members), and the American Institute of Chemical Engineers (400 members), meet in Canada, that practically untapped reservoir of resources, to discuss the problems of individual and group welfare as they respectively see them.

As capitalist-producer, educator, workman, and as administrator of the precepts of science in the elaboration and conservation of material and labor, these groups, with transportation, represent the essential elements of our material civilization.

Between 1900 and 1917, Canadian manufacturing plants increased in number from 14,650 to 34,392; the capital invested therein from 446 millions to 2,700 millions; the value of goods produced from 481 millions to over 3,000 millions; and in the last fiscal year Canada's exports were 40 per cent. of this sustained production.

While Great Britain has been responsible largely for the expansion of the Canadian railroad system, the United States has played the greatest part in Canadian industrial expansion as the investor of over 1¼ billions of dollars. Five hundred branches of American industries are located in Canada.

Canadian industry's record for service is unapproached.

NEVER in history have the people been so well informed, and so sorely needful of education. American newspaper editors considered the scarcity of newsprint in the region of its most abundant production.

The intimate connection of a chemical product with the cultivation of sound thinking thus is illustrated.

Education in the immutable principles that govern the orderly relationship of men, slow as the process may be, is the only cure for the lack of faith that animates a determining element of our people.

THE American Federation of Labor proposes to make six hours a day's work, in pursuance of the disturbing doctrine that the less one does the more there is for his fellows to do, that such procedure contributes to stability of employment, and hence to the welfare of the worker.

Why this deliberate contradiction of economic fact that the wage is paid out of what is produced; that with less produced the wage must be less; that the wage is what the wage will buy?

Why this persistent flouting of natural law, with its inevitable penalty, when obedience to it would transform the world?

The value of a man to society is determined absolutely by the quality and quantity of his contribution to its service.

When all the virtues of co-operation are prostituted to a pernicious philosophy that places individual or class welfare above that of all, well may men lament the slow progress of the educative process, to which, in the long run, one must look for the alleviation of the ill-adjustments of the social order.

ALTHOUGH the chemical and allied industries of Canada number only 500 of the aggregate of 34,392 manufacturing plants, they are of the first order of importance in her economy.

In recognition of her progress in this field, and of her possibilities in material and power, the American Institute of Chemical Engineers holds its meeting within her borders.

This organization in its purposes, personnel and conduct, exemplifies, on an industrial plane, the principles that determine individual progress and social advancement.

While invidious distinctions cannot be escaped, the idea of an organization whose membership should represent demonstrated fitness and unimpeachable integrity, is in line with the always wise encouragement of capacity and service.

Numerically weak, it cannot be said that its influence is proportionately great, so long as so many capable practitioners of the chemical profession are without its portals.

Nevertheless its members typify a class, whose stock in trade is service, and to which, more than to any other one source, the world is indebted for the productivity of labor; and without whose contributions to public service, through the effort to advance one's self, the wage rate to-day never would be possible.

CONDEMNATION of class aggrandizement is savored often with unthinking abuse of class itself as a social instrument.

Consciousness of kind is a primal attribute; a state of society without segregation of the like is unthinkable; democracy is a dream.

Development of class is at the basis of economic growth. Efficiency demands it; and efficiency is the lode star of industry.

In America class is characterized by the high mobility of its membership, and fecundity of opportunity in the freest and fairest of all civilizations.

The role played by class is defeated when, organized, it seeks something for nothing; when, drunk with power, it seeks to terrorize the whole, of which it is a part, into giving it that which it has not earned.

We can get only as we give; and until organized and militant class learns that lesson, it will be a menace to government whose institutions are founded on that principle.

AFTER a decade of discussion the Federal water power development bill is now a law.

The growing inadequacy of our power resources in coal, oil and gas, and the increasing burden upon a stifled railroad system of wasteful transportation involved in the carrying of coal, emphasize the wisdom of the encouragement of private enterprise in hydro-electric power development at a time when our industrial expansion is predicated, as never before, upon cheap energy.

The importance of this subject to the electro-chemical industries cannot be over-estimated, for their growth depends upon the continuous availability of power at a figure comparable with that of competing nations more advanced in the development of their water power resources with respect to markets.

JOHAN L. HARPER, vice-president and chief engineer of the Niagara Falls Power Co., discusses in this issue of *CHEMICAL AGE* the course that has been pursued in this country in the development of hydro-electric power.

Succeeding the isolated development of specially favored localities has come, with industrial expansion and increasing dependence upon diminishing supplies of commercially available fuels, a broad survey of our potentialities in water power and a filling in of parts with respect to the ultimate development of a well-rounded whole.

Of the latter type of engineering planning for the utilization of water power, particularly in a region where those resources are least and the power demand greatest and hence the necessity for energy conservation most urgent, is the super-power plan for the trunk-line transmission of electrical energy, from coal mines

and available water powers of the north-east Atlantic region, to the industrial and municipal consumers from Boston to Washington and as far north as Albany.

The maintenance of a progressive standard of living compels intensive development of all agencies that will relieve men from the coarser grades of industrial work, to say nothing of the relief afforded to a transportation system whose growth to the needs of the country unwisely has been denied.

Electricity is energy without bulk.

The co-ordination of all means for its production in regions best adapted for its transformation, either from bulky material or from water flowing without service to the sea, is a problem whose early solution on a national scale now can be seen.

HENRY HOWARD'S annual report as chairman of the executive committee of the Manufacturing Chemists' Association directs attention to the function and activities of an organization of chemists which two years hence will celebrate the fiftieth anniversary of its origin.

Antedating the American Chemical Society by four years, this body of business chemists has witnessed the growth of a congeries of industries from crude, empiric arts to scientific industries of the first order in our national economy.

To observe and study business conditions and tendencies as they may affect the chemical industry, to represent it when assailed by political influences inimical to its welfare, to advance every movement contributing to its development, and, while preserving independent identity and the competitive process vital to growth, to foster among its members that cooperation equally essential to service, is work calling for the finest type of the business chemist.

Cooperating with this organization are the American Dyes Institute, the Chemical Alliance, Inc., and the Chemical Foundation, Inc.

That necessary dyestuffs legislation has been sacrificed temporarily to political controversy only should impel the business chemist to renewed effort to protect the industry, to the advantage of the country, from that hostile competition that blasts and sears.

THE political horizon of the business chemist will enlarge with the growing popular appreciation of the place of the technical man in a society preeminently industrial.

Portents thicken that the problems of leadership will return to men who, while not without vision or receptivity to the impulses of the ideal, walk among men and bear the responsibilities of the common service.

You cannot derogate management that has created industry and expect the crowd to rule, if the orderly processes that condition progress are to survive.

The Business of Chilean Nitrate Production

Chile is the only country in the world known to contain commercially important deposits of nitrate of soda.* Two grades of nitrate are produced: 95 per cent., or ordinary nitrate, which is used for fertilizer purposes; and 96 per cent., or refined nitrate, which is used for manufacturing purposes. Before the war, approximately 75 per cent. of the nitrate marketed was of the lower grade. Private business in Chile and Government revenue are both dependent on the prosperity of the nitrate industry, since this one product ordinarily constitutes nearly 80 per cent. of the country's exports, and the export tax on nitrate and its principal by-product, iodine, constitutes more than half the Government's total income.

The nitrate fields, the principal source of Chile's wealth, are limited to a narrow strip of arid desert located on the eastern slope of the coastal range, west of the cordillera of the Andes, at an altitude of from 2,000 to 5,000 feet above sea level, and inland a distance varying from 16 miles in the northern part of the zone to 90 miles in the southern part. This region extends south from the valley of the Camarones river, the northern boundary of the Province of Tarapaca, to the southern boundary of the Province of Antofagasta. Outside of this area there are only the negligible deposits in the Province of Tacna, and a few isolated deposits whose exploitation on a commercial scale is practicable in the Province of Atacama.

There is a great deal of speculation concerning the probable duration of the beds, but the very range of the conclusions arrived at shows on what inadequate data they have been based. One expert estimates the explored deposits to contain 240,000,000 metric tons of nitrate, and calculates the contents of the unexplored region to be twice as large. According to these figures it would require over 240 years to exhaust the supply at the present rate of production. Other estimates are less optimistic and set a much earlier date for the exhaustion of the beds.

The Five Nitrate Districts

The nitrate region consists of five important districts, namely, Tarapaca, Tocopilla, Antofagasta, Aguas Blancas, and Taltal, and a few smaller deposits somewhat detached from these main fields, such as El Boquete, Pan de Azucar, Providencia and Pampa San Juan. The relative importance of the principal districts is shown by the following table, giving the number of oficinas producing plants operated in each district, the extraction of caliche (the raw product from which nitrate is produced), and the amount of nitrate derived, during 1917:

Districts	Oficinas in operation	Caliche mined, metric tons	Nitrate produced, metric tons
Tarapaca	76	10,330,984	1,302,921
Tocopilla	7	1,822,334	227,900
Antofagasta	30	9,172,026	1,076,568
Aguas Blancas	7	1,066,473	145,590
Taltal	9	1,923,257	248,053
Total	129	24,315,074	3,001,032

Each of these zones is an independent unit with its own ports and railways. The Tarapaca district has four ports, Iquique, Pisagua, Caleta Buena and Junin, and these ports are connected with the nitrate fields by

the Nitrate Railways Co., the Agua Santa Nitrate & Railway Co., and the Junin Nitrate Railway Co. The Tocopilla district has one outlet, the port of Tocopilla, which is connected with the interior by the Anglo Chilean Nitrate & Railway Co. The Antofagasta district has two ports, Antofagasta and Mejillones and is served by the Antofagasta & Bolivia Railway. The Aguas Blancas district is served by the port of Caleta Coloso and the Antofagasta & Bolivia Railway. The district of Taltal has only one port and one railway, both bearing the name of the district.

Mining and Refining Caliche.

Caliche differs in appearance and composition in various zones. It usually contains (besides sodium nitrate) sodium chloride, sodium sulphate, potassium nitrate, sulphates of lime and magnesia, sodium iodate and sodium bichlorate in varying proportions. The sodium nitrate content varies from less than 10 per cent. to over 70 per cent., the average sodium nitrate content of the caliche extracted during 1917 being 17.48 per cent.

The mining of caliche is very simple. A small shaft is sunk through the surface strata and through the caliche layer; a charge of powder or dynamite is inserted and exploded, and the lumps of caliche are sorted by hand from the resulting debris and loaded on carts. These carts carry about two tons and are drawn by from three to six mules. If the distance to the refining plant is short the caliche is delivered direct, otherwise it is reloaded on light freight cars for shipment.

Arrived at the oficina or maquina, as the refining plant is sometimes called, the caliche is first crushed and then boiled in a huge tank of water. This boiling dissolves the nitrate and other salts and leaves the sand and similar refuse on the bottom of the tank. The dissolving process completed, the nitrate solution is drawn off into a large shallow vat and cooled sufficiently to precipitate the sodium chloride. After this precipitation, the solution is again drawn off and cooled to a point at which the sodium nitrate crystallizes. When the nitrate has crystallized on the bottom and sides of the vats the remaining liquor is pumped off and the nitrate crystals thoroughly dried and packed for shipment.

By-Products of the Nitrate Industry—Waste in the Industry

Iodine, the most important by-product of the nitrate industry, is extracted from the liquor which remains after the nitrate has been precipitated. Although some sodium iodate is contained in practically all caliche, iodine is produced by only a portion of the nitrate companies, and the output of these companies is carefully regulated by a producers' trust in order that the limited market may not be overstocked. The average pre-war exports amounted to approximately 475,000 kilos annually; but during the war, the exports were much larger: 708,800 kilos in 1915, 1,323,000 kilos in 1916, and 759,000 kilos in 1917. Germany was the principal purchaser of iodine before the war, the United States second and Great Britain third.

Another by-product, nitrate of potassium, is engaging the attention of various experts. One chemical engineer asserts that this salt exists in the caliche throughout all parts of the nitrate region and that

*Latin American Circular No. 67, prepared by the Latin American Division, Bureau of Foreign and Domestic Commerce.

the caliche used by at least a hundred of the oficinas contains from 1 to 2 per cent. An American company is reported to have perfected a refrigerating process by means of which it can manufacture this by-product at small cost.

The nitrate producers are ultraconservative and have made few changes in the methods of mining and refining caliche since 1884 when the nitrate deposits first came into Chile's possession. According to the best authorities, the waste of nitrate in mining now amounts to no less than 40 per cent. of the total nitrate content of the caliche extracted; and the waste of the nitrate at the oficinas, given in terms of the nitrate content of the caliche brought to the oficinas, amounts to no less than 35 per cent. In 1884, the caliche refined averaged as high as 51 per cent. nitrate content; and, consequently, nitrate production was a profitable industry in spite of the inefficiency of the process used, but now that the caliche averages only 17 or 18 per cent nitrate content this process is far too wasteful.

The lower yield of nitrate from the caliche, the higher cost of labor and supplies, and the fear of competition of the synthetic product are combining to make the producer anxious to increase the efficiency of the industry. Chemists are at work studying the composition of the caliche and chemical engineers are experimenting with changes in the method of mining and refining. Already some of these experiments have resulted in reduced production costs.

Cost of Labor and Supplies in the Nitrate Fields.

The laborer in this arid zone requires great strength and endurance under the most trying of living conditions. The nitrate region produces no fresh fruits or vegetables and he is obliged, therefore, to live largely on imported canned goods. He receives a far higher wage than any other class of Chilean laborer, but on the other hand the cost of all the necessities of life are exceedingly high. To compensate the laborer for the hardships of the situation, the nitrate operators are compelled to provide living quarters for employes and their families and to maintain stores where they can purchase food, clothing and household furnishings.

At the outbreak of the war, 53,000 laborers were employed in the nitrate fields. Immediately afterwards this number materially decreased, but in 1915 it began to increase again and in 1917 had reached 56,000. Of this number, some 43,000 were Chileans and the remainder largely Peruvians and Bolivians. Before the war the average daily wage of the nitrate laborer was 6.48 Chilean paper pesos, and in 1917 the average wage was 6.81 Chilean paper pesos. In 1914 the exchange value of the paper peso was about \$0.20; during the war its value fluctuated between \$0.14 and \$0.33.

Nitrate producers must import all their supplies, such as fuel, machinery and parts, and bags in which to ship the nitrate; and the cost of all these commodities has increased materially during the last few years. One manufacturer reported in 1918 that petroleum, which had formerly cost 41½ shillings (\$10.98) per ton, then cost 150 shillings (\$36.45); that the cost of coal had increased from 29 shillings to 115 shillings (from \$7.06 to \$27.95); and that jute bags, which he had formerly purchased for 3½ pence (\$0.07) each, had reached the high figure of 22 pence (\$0.46). A million tons of fuel were consumed in nitrate mining and refining in 1917. Of this total 65.5 per cent was petroleum, 28.6 per cent coal, and the remainder such fuel substitutes as straw and grain. Apparently no wood was used. Before the war most of the coal was

imported from Great Britain. Petroleum comes principally from Mexico and the United States.

Nitrate is packed for shipment in jute bags holding about 200 pounds each. These bags are imported from India and about 30,000,000 of them are ordinarily used each year.

Relative Importance of Native and Foreign Companies

The greater part of the capital invested in the nitrate industry is Chilean and British. The amount of American capital in the field is relatively small but is increasing. German interest in the business was growing until checked by the war. The comparative importance of the native and foreign nitrate plants can be judged by their proportionate share in the total production for the year 1917, as shown in the following table:

Nationality.	Oficinas, number.	Production, metric tons.	Total production, per cent.
Chilean	54	1,272,723	42.41
English	44	1,133,293	37.76
Slavic	7	163,150	5.44
German	7	161,044	5.37
American	2	78,549	2.62
Peruvian	7	75,681	2.52
Spanish	4	69,672	2.32
Other	4	46,920	1.56
Total	129	3,001,032	100.00

Sixty per cent of the nitrate manufactured by Chilean companies is the product of five large concerns: Compañía de Salitre de Antofagasta, Compañía Salitrera El Loa, Compañía Salitrera El Boquete, Compañía Salitrera Lastenia, and Compañía de Salitres y Ferrocarril de Agua Santa.

La Compañía de Salitre de Antofagasta is the oldest and one of the most important nitrate producers in the country. It owns a strip of nitrate land about 32 kilometers long by 4 kilometers wide in the Antofagasta district and employs 15,000 men. Its oficinas consume 80,000 tons of coal yearly, and the public stores which it has established at its plants purchase 8,000,000 paper pesos' worth of general merchandise annually. It produced 340,000 metric tons of nitrate during 1917, 10 per cent of the total amount manufactured during the year. In connection with its nitrate business, the company has built up a large general import and export business, for which it maintains a fleet of four tugs and about a hundred barges at Antofagasta.

Compañía de Salitrera El Loa owns some 14,000 acres of land in the Antofagasta district about 95 miles from the coast on the Antofagasta and Bolivia Railroad. It has seven oficinas and produced nearly 212,000 tons of nitrate during 1917. Compañía Salitrera El Boquete has two oficinas, located in the Antofagasta district, and produced 94,000 tons of nitrate in 1917. Compañía Salitrera Lastenia, also located in the Antofagasta district, has two oficinas and produced 79,000 tons of nitrate during 1917. Compañía de Salitre y Ferrocarril de Agua Santa owns six oficinas in the Tarapaca district and manufactured 55,000 tons of nitrate in 1917.

Important Foreign Companies.

The 1917 statistics show eight English companies whose annual production of nitrate amounted to over 50,000 metric tons. The combined output of these companies represented over 60 per cent. of the total quantity of nitrate manufactured by English firms during that year.

The following table gives the name of each of these

eight companies, the number of oficinas owned, the location of the oficinas and the 1917 production of nitrate:

Companies.	Oficinas, number.	Location.	Production, 1917, metric tons.
Alianza Co. (Ltd.).....	3	Tarapaca district.....	137,896
Anglo Chilean Nitrate & Ry. Co.....	3	Tocopilla district.....	119,124
Lautaro Nitrate Co.....	3	Taltal district.....	105,223
Liverpool Nitrate Co.....	3	Tarapaca district.....	74,460
Amelia Nitrate Co.....	3	Antofagasta and Tarapaca districts.....	66,111
Fortuna Nitrate Co.....	3	Antofagasta district.....	65,206
Rosario Nitrate Co.....	3	Tarapaca district.....	64,692
New Tamarugal Nitrate Co.....	2	do.....	61,380

There are four German nitrate firms. These companies are equipped to produce considerable quantities of nitrate, but were forced to close many of their plants during the war and, therefore, their 1917 production does not represent their normal output. Compañía Salitrera H. B. Sloman owns four oficinas in the Tocopilla district, two of which were open in 1917, and produced 58,000 tons of nitrate. Compañía Salitrera Alemana owns four oficinas in the Taltal district, only one of which was operated during 1917, producing 42,000 tons of nitrate. Salpeterwerke Gildemeister A. G. owns three oficinas in the Tarapaca district, all of which were operated during the year; their total output was 50,000 tons. Salpeterwerke Augusta Victoria A. G. owns only one oficina. This oficina is located in the Antofagasta district and produced 10,000 tons of nitrate during the year.

The Grace Nitrate Co. and the Du Pont Nitrate Co. are the only American companies producing nitrate in Chile. The Grace company owns a well equipped oficina in the Tarapaca district where it employs more than a thousand men. The company produced 42,000 tons of nitrate during 1917, all of which was sent to the United States. The Du Pont company has one oficina in operation in the Taltal district and is building a second in the Tarapaca district. Its nitrate production for 1917 was 35,000 metric tons.

The firm of Baburizza, Lukinovic y Cia. was founded by two members of the Slavic colony in Chile and one Chilean, and might be considered Slavic, although it is registered in Chile. The company owns three oficinas and some 69 square kilometers (1 square kilometer equals 0.386 square mile) of nitrate land in the Antofagasta district. It employs 2,200 men at its nitrate plants and produced 123,000 tons of nitrate during 1917.

Markets for Chilean Nitrate.

The market for nitrate steadily increased and Chile's profits from the exploitation of this natural monopoly increased proportionately until the beginning of the war when the European demand for nitrate fertilizers practically ceased. Fortunately for the nitrate producers and for Chile, however, the Allies soon found that they needed this product for the manufacture of high explosives; and needed it so badly that they were willing to pay high prices, allocate shipping space to carry it from Chile to the United States and Europe, and furnish the necessary supplies to the producers in Chile; as a result, the intense depression which had begun with the declaration of war was quickly succeeded by an unparalleled prosperity.

The steady increase of the normal pre-war demand for Chilean nitrate, the depression occasioned by the outbreak of the war, and the subsequent recovery

are all reflected in the following statistics of annual production and exports for the 10-year period, 1909-1918:

Years	Production, metric tons	Exports, metric tons	Years	Production, metric tons	Exports, metric tons
1909....	2,110,961	2,134,958	1914....	2,463,356	1,846,783
1910....	2,465,415	2,335,941	1915....	1,755,291	2,023,394
1911....	2,521,023	2,449,515	1916....	2,912,893	2,980,227
1912....	2,585,850	2,493,082	1917....	3,001,032	2,776,289
1913....	2,772,254	2,738,339	1918....	.....	2,960,088

The Market During 1919.

The cessation of hostilities in Europe brought to a sudden and complete halt the need of nitrate for ammunition manufacture and precipitated a period of depression similar to that of 1914. The decline in the market necessitated the closing of a considerable number of the oficinas and the curtailment of production at others; quotations of nitrate stock slid steadily downward; the efforts of the association of producers to maintain selling prices partially failed and they were forced to yield bit by bit in order to sell even a portion of the nitrate stocks rapidly accumulating on the Chilean coast.

Great Britain, Germany and United States Formerly Chief Markets

The United Kingdom, Germany and the United States were the chief markets for Chilean nitrate before the war, the three together taking approximately five-sixths of the total exports during 1912 and 1913. France, Belgium and Holland ranked first among the lesser markets. The statistics of the war years are of relatively little value in gauging the future demand in any country engaged in the European War; Germany and Belgium, formerly good markets, were unable to import any nitrate; the United States, France and Italy increased their imports, but used most of it for ammunition manufacture. From the point of view of the dealer who wishes to estimate the future for nitrate, perhaps the most significant development of the years 1917 and 1918 is the marked increase of nitrate exports to Japan.

The following table shows the exports of nitrate from Chile by countries of destination for the pre-war years 1912 and 1913 and the war years 1917 and 1918:

Countries of destination	1912 metric tons	1913 metric tons	1917 metric tons	1918 metric tons
United Kingdom...	994,625	1,004,979	756,902	823,269
Germany.....	565,722	629,298	.....	.....
United States....	484,902	630,790	1,512,577	1,962,552
France.....	108,880	121,472	139,866	20,305
Belgium.....	92,929	118,690	.....	.....
Holland.....	98,747	100,379	43,997	.....
Italy.....	9,306	10,684	67,961	6,900
Japan.....	21,707	28,342	50,773	47,512
All other.....	116,264	93,705	204,213	99,545
Total.....	2,493,082	2,738,339	2,776,289	2,960,088

1919 Imports Into United States.

After the signing of the armistice the United States Government no longer needed the nitrate purchased for war purposes and transferred the amount on hand from the War Department to the Agricultural Department for distribution to the farmers. This amount, plus a considerable quantity already held by the Agricultural Department, was sold at cost. As long as these stocks were available at low prices, there was little chance for the sale of privately held nitrate, but the last of this supply was disposed of in the spring of 1919 and subsequently all Government restrictions on nitrate imports were removed. The nitrate dealer has a free market once more and what is of equal importance in his estimation, the Government plants for the manufacture of synthetic nitrate have been closed. Imports of nitrate of soda into the United States for the year 1919 were 407,459 long tons, about 65 per cent. of the 1913 imports.

Apparently a relatively small proportion of the nitrate imported into the United States is used for fertilizer purposes. According to the War Trade Board, about 40 per cent. is ordinarily used in the manufacture of explosives, 13 per cent. for fertilizer, and the remainder for making sulphuric acid and for miscellaneous purposes. The Department of Agriculture reports that 564,000 tons were imported during 1914, of which amount 162,000 tons, about 29 per cent., were used for fertilizer purposes.

European Sales Restricted During 1919.

About 80 per cent. of the nitrate imported into Europe is ordinarily used for fertilizer purposes. It is said that there was an active demand for these fertilizers last year, but Government restrictions, accentuated by the lack of shipping space, greatly restricted sales, especially during the early part of the season when the demand was strongest.

Great Britain had contracted for 680,000 tons of nitrate shortly before the signing of the armistice, practically all of which became available for ordinary market uses, and import restrictions were not removed until the major part of these Government stocks had been disposed of. Since the middle of May, when Government restrictions were finally removed, imports have been greatly hampered by the lack of available tonnage.

Germany has been unable to import nitrate because of the continuance of the blockade, but it seems unlikely that it would have been able to do so anyway, as at the present depreciated value of the mark, the selling price of nitrate fertilizers would be prohibitively high.

The reduction of acreage under cultivation in France and Belgium has somewhat curtailed the demand for nitrate fertilizers, but it is stated that consumption would have been nearly double what it was during the first half of the year had it not been for the congestion at the ports, the disintegration of the interior transport service and Government restrictions.

Chile has been greatly alarmed by this depression in the market for nitrate and by rumors hinting that nitrate was to be supplanted in Europe and America by two rivals, namely, sulphate of ammonia, a by-product of coke, and synthetic nitrate produced by electric fixation of atmospheric nitrogen. To fully appreciate this alarm, it is essential to comprehend how dependent the nation is upon this one export.

Chile buys the bulk of its manufactured products abroad and pays the bill with the raw products exported, nearly 80 per cent. of whose value is represented by nitrate sales. Therefore the value of the

Chilean peso abroad is directly affected by the market for nitrate, and nearly all private business in Chile is indirectly dependent on the nitrate industry.

Government Aid to Producers.

The vital importance of the nitrate industry to the Chilean Government is graphically illustrated by the following facts: For the period 1901-1917 the export duties on nitrate and its principal by-product, iodine, constituted 62 per cent. of the total revenue received; during 1913, the last pre-war year, they constituted 57 per cent. of the total revenue; and during 1917, the last year for which these statistics are available, they formed 65 per cent. of the total. The Government can not afford to allow the exports of nitrate to decline nor can it afford to have the 50,000 laborers ordinarily employed in the nitrate fields idle.

During the depression of 1914 the Government arranged to make temporary loans to the producers in order that they might not have to close their plants. Under this system the nitrate companies desiring them were issued Government bonds, which they were at liberty to sell in the open market. These advances were to be guaranteed on nitrate stocks and to be refunded plus the accrued interest when said stocks should be sold. These arrangements have been continued up to the present time.

Further evidence of the Government's interest in the welfare of the nitrate industry is afforded by the recent appropriations to the newly established industrial school for nitrate research; by the recognition accorded the scientific society lately formed by a number of Chilean and English nitrate companies; and by two plans recently discussed to centralize sales under Government control, and to alter the basis of the nitrate tax, but no definite action has been taken. The nitrate tax as now imposed is a fixed amount, 2s. 4d. (\$0.568) per Spanish quintal of nitrate exported, and the cost of production varies according to the nitrate content of the raw material exploited and according to the size and efficiency of the reducing plant, wherefore some companies realize much larger profits than others. Under the plan now being discussed the tax would be levied on the profits of the companies rather than on the amount of nitrate exported.

Protective Association Formed by Companies.

During the recent crisis a second attempt has been made to organize the nitrate producers into an association which shall limit production and centralize sales, the object being to allow only as much nitrate to be exported as the consuming markets can absorb at a price high enough to afford reasonable profits to the producers. The first association was formed in 1901 and ceased to exist in 1909 because of a disagreement concerning production allotments to certain companies. The present association is the outgrowth of the former association and the Nitrate Propaganda Committee organized by the English companies about 1889 and later known as the Asociacion de Sulfato de Propaganda. This association has had headquarters in Chile and has had two distinct prerogatives: To keep a complete statistical record of the progress of the nitrate industry, and to increase the world market for nitrate through the education of the public as to its uses. For this latter purpose propaganda committees have been maintained in France, Germany, Belgium, Holland, Spain, Italy, the United States, Japan, Egypt, Cuba, Australasia, England and Wales.

The directors of this association felt the necessity of forming an organization which would have some control over the entire industry, that this organization should consist of the producers, and that it should be

free from any sort of Government control. They therefore appointed a committee to study the situation and draw up a plan for such an organization. This plan was presented and accepted at a meeting of the producers held in January, 1919.

All the Chilean and English producers are now members of this association, and it is reported that the four German companies are to be admitted in the near future. The two American firms, the Grace Nitrate Co. and the Du Pont Nitrate Co., have not joined the association.

Financial Condition of Producers.

The profits of the last few years have afforded many of the producers an opportunity to fortify themselves against this anticipated period of depression. The following statistics, compiled from recently published reports, of some of the more important English and Chilean companies illustrate to what extent they have taken advantage of this opportunity.

The 14 English companies which close their year in December had a total capitalization of £4,189,000 at the end of 1918 and £404,900 outstanding in debentures against which they had £1,216,359 in reserves and £786,573 in their carry forward accounts. They had distributed £592,275 in dividends for the year, an average of 14.1 per cent., and had added £155,000 to the reserves and increased their carry forwards. The value of the pound sterling is \$4,8665 at normal exchange.

La Compañía de Salitre de Antofagasta, the largest nitrate producing company, made a profit of 22,305,520 paper pesos for 1918, out of which 11,520,000 was distributed in dividends, 10,000,000 added to funds for exploitation and amortization of property, and the remainder to a contingency fund. The company is capitalized at 16,000,000 paper pesos, has a reserve

fund of 2,000,000, a contingency fund of 2,674,955, a fund of 32,000,000 for exploitation and amortization of property, an insurance fund of 2,500,000, and a fund of 2,000,000 paper pesos to provide for fluctuation in exchange.

Compañía Salitrera El Loa, another large Chilean company, made a net profit of £450,314 during 1918, out of which £227,500 was distributed in dividends, £200,000 placed in the fund for amortization of oficinas and land, and the balance placed in the dividend fund.

Compañía Salitrera Lastenia made a net gain of £184,197 during 1918, out of which £124,800 was distributed in dividends, and the remainder placed in the dividend fund. This company is capitalized at £624,000, has a reserve fund of £20,000, a fund of £8,029 for operation, a fund of £14,024 to provide for the fluctuations of exchange, and a dividend fund of £75,795.

Outlook for Future Reassuring.

According to the representatives of the association abroad the prospective demand for nitrate fertilizers for use on next year's crop is excellent. The largest problem is that of ocean transportation; indeed so serious is this one factor that the sales for some time to come will probably be limited by the available shipping space and the prevailing freight rates. Uncertain exchange and disturbed political and economic conditions in Europe will tend indirectly to reduce consumption also.

The association reports the present outlook decidedly encouraging, although no spectacular recovery is anticipated. It is estimated that exports for the present nitrate year (July 1, 1919, to June 30, 1920) will not exceed 30,000,000 Spanish quintals.

The Norwegian Chemical Industry

The chemical industry of Norway reflects the character of its chief raw material, which is hydro-electric power, of which its resources are the most abundant of European nations.

Its exports of electrolytic and nitrogen fixation products for 1918 and 1919 are shown in the following table. Norway saltpeter, which is nitrate of lime, is a fertilizer ingredient of increasing application in European agriculture.

	1918	1919
Chemicals	Kilos	Kilos
Nitric acid	836,686	1,432,752
Oxalic acid	206,028	293,403
Ammonium sulphate		232,463
Ammonium nitrate	49,587,663	5,163,075
Sodium nitrate	2,636,553	13,036,351
Sodium nitrite	2,097,811	1,893,949
Norway saltpeter	53,625,250	63,880,171
Cyanamid	10,490	9,929,862
Calcium carbide	41,771,876	25,599,316
Ferrosilicon	16,861,278	2,458,029
Iodine	5,373	3,042
Matches	5,014,918	4,653,834
Gunpowder and other explosives	4,960	8,645

Dr. George D. Van Epps, formerly non-ferrous and oil chemist for the Continental Motors Corp., Muskegon, Mich., is at present analytical chemist for the Citro Chemical Co., Maywood, N. J.

Senate Committee Reports Favorably the Wadsworth Bill for Government Operation of Nitrate Plant No. 2

The Senate Committee on Agriculture and Forestry, which has had under consideration for the past year the proposal of the War Department for the government operation of Nitrate Plant No. 2, built at Muscle Shoals, Ala., by the Air Nitrates Corp. for the production of ammonium nitrate, has reported favorably the Wadsworth Bill (S. 3390), which seeks to effectuate this proposal by legislative enactment.

Thus is shifted to the Congress the problem of the disposition of the government's investment in chemical manufacture. Nationalization of industry and elementary instruction in agricultural chemistry and political economy soon will be subjects of popular comment.

The National Association of Manufacturers has prepared a "platform of industry," which will be incorporated in the forthcoming political platforms, and which will have direct application to the elimination of government from private enterprise.

The public rapidly is being educated to the importance of the chemical industry in our national economy.

Chas. Lyon has been appointed secretary and sale manager of the Phosphate Products Corp., of Richmond, Va. The company has a large plant at Charleston, S. C., for the manufacture of calcium acid phosphate.

Power for Electrochemical Plants

By John L. Harper

Vice-President and Chief Engineer, The Niagara Falls Power Company

Two systems of thought that have made for progress in the development and application of power.

The first of these is that of adding a little bit to the little that we had before, thus making a little bit more, or a small step out into the unknown.

The second system represents the analysis of the ultimate, the determination of the ideal to be accomplished, and the weaving in of the present work as one more thread in the production of the whole fabric representing the ultimate possibilities and ideal treatment.

The first system was useful when both the ultimate and ideal were unknown; it has, as it were, produced the steps necessary for climbing the mountains so that wider views could be obtained from their tops. The time has now arrived when advantage must be taken of these broadened views, and future activity must be directed by following out the second system of thought.

Investigations have been carried on by Governmental and other bodies, so that we now know within reasonable limits the final amount of hydro-electric energy that will be available to the country. Explorations of coal and other fuel deposits have given the same class of information in regard to the extent of those sources of power.

As the production of power for industrial purposes at the present time is practically restricted to two sources of energy, namely, fuel and water power, the direction of advance in power development must be such in the future as properly to balance expenditures and use between these two sources of power, in order that as little waste of energies and values as possible may be made, and that neither source may be called upon to supply uses for which the other is sufficient and better fitted.

It is encouraging to note that the thoughts of engineers are now being directed toward the ideal solution of the problems of industry; that the second system of thought is finally being allowed to make itself known and the voice of the far-sighted turtle is beginning to be heard in the land. The suggestion, at one of the last meetings of the American Institute of Electrical Engineers, of the "Super Power Zone," and the discussions of this project by prominent engineers show the trend of development of this line of thought.

Both fuel power and water power will have proper applications for the supply of either continuous power outputs or intermittent power outputs. In the adaptation of fuel power to the different kinds of loads or uses, the fundamental governing features lie almost entirely in the adaptation; whereas water power may have in itself certain fundamental governing conditions that are outside of the control of man and exist regardless of the requirements of use.

These inherent characteristics of water power may be considered under certain headings suggested by the methods of supply and development obtaining in each specific case.

I. There are rivers whose natural fluctuating flow may be developed without storage or pondage.

II. Rivers whose flow may be developed with partial or complete storage.

III. Developments where long time storage is impossible but pondage for daily use is possible.

IV. Streams where storage is complete, even extending over terms of years, but where no pondage is possible.

Each of these forms of water power development is capable of producing a class of power that adapts itself to particular lines of industry. The purpose of this paper* is not to state some new thing, but simply to call attention to these fundamental facts which, fortunately or unfortunately, are neither controlled by the mass of public opinion as expressed by politics, or by the opinion of individuals, as represented by the business or financial aspirations of power developers.

Engineers today must carefully consider both the source of power and the use to which the power is to be put, and then lay out development and distribution systems that do not waste power in attempting to serve one class of industry from sources of power that are peculiarly adaptable or even vital to other forms of industry.

The power from the first three classes of development above mentioned is more or less adaptable to intermittent uses, and may be used either to supplement each other in their development and distribution, or may be used in conjunction with or supplemental to power developed from fuel; and in some cases, where the power is continuous, though small, it may be supplemented by fuel power.

The power from the fourth class, which exists in such streams as the Niagara and St. Lawrence, where the storage is complete and where no pondage is possible, has peculiar basic characteristics that differentiate it from all others. The most important of these are the enormous amount of power available at one place, and the wastefulness of using it otherwise than as continuous twenty-four hour power 365 days in the year.

In the broad field of the location of electro-chemical and electro-metallurgical enterprises, the fact is that these industries must go to those locations where continuous power is available in large quantities, where transportation is such that the raw materials may be easily and cheaply obtained, where transportation of the finished product is the shortest to the location of the customer, and where the living conditions are such that labor may be obtained.

The above paragraph is not intended to discourage those efforts which will always exist and the hopes which will always struggle for the development of processes which are planned to till in the valleys of low load factor uses of power. These efforts will always exist, and some will succeed and the remainder, after varying failures will naturally gravitate to continuous power centers.

At Niagara Falls, the local potential hydro-electric power is approximately 5,000,000 kilowatts. The Niagara River, however, is an international boundary, and a part of the water belongs to each country; there-

*Presented at the recent Boston meeting of the American Electro-Chemical Society and American Institute of Electrical Engineers.

fore, the diversions for power purposes must necessarily be controlled by international treaties which will protect each country in the receipt of its rightful amount of power. If, in this case, the division were made on a 50-50 basis, the part of the energy coming to the United States would be 2,500,000 kilowatts.

Factors, such as the continuity of the border stream, protection of navigation, and the maintenance of spectacle, makes it improbable that more than 60 per cent. of the potential energies of the Niagara will, in the near future, be developed and used for industrial purposes. Such a development would make available 1,500,000 kilowatts of electrical power on the American side at Niagara Falls. A similar development on the St. Lawrence, throughout that part of the river where it is a boundary stream, would result in an increase of the amount of this form of power; but, as the available head in this part of the St. Lawrence River is 66 feet, compared with 300 feet available in the Niagara district, it may be reasonable to assume that the total amount of continuous hydro-electric power in the north and eastern section of the country will not be in excess of 1,900,000 kilowatts.

Even in an industrial community whose basic and principal feature of industrial development is that of electro-chemical and electro-metallurgical processes, the power available cannot all be used for these processes, but the secondary fabricating and manufacturing interests as well as municipal requirements must be taken care of, so that the final application of power from these sources to electro-chemical and elec-

tro-metallurgical work will not represent more than 1,500,000 kilowatts.

This amount of energy is meager indeed in the light of the present development and advance made in these processes, and it, therefore, behooves thinking citizens of this country to object to the frittering away of their heritage of continuous power for any purposes that can be supplied from sources adapted to intermittent service.

So vital are the products of electro-chemical and electro-metallurgical processes to the functioning of the industry of America, that should the production of ferro-alloys, phosphorus compounds, abrasives, electrodes and other special chemicals and gases be discontinued from the present development on the Niagara frontier even for thirty days, the effect would be reflected in the closing down of hundreds of industries throughout the land, especially those using electric furnaces that require electrodes, all forms of manufacture of machinery, automobiles, railway engines, rails, etc. There are also thousands of other applications of these products which touch every city, town, hamlet, and almost every family in our commonwealth. Community life and health is safeguarded, transportation of necessities and luxuries is cheapened and made more certain, and added safety, enjoyment and pleasures are brought about by the existence of those vital and necessary products of the electro-chemical and electro-metallurgical plants, whose development may be handicapped and whose existence may be threatened by the misapplication of our vital and limited sources of continuous power.

Present Status of the American Potash Industry

By Frederick W. Brown

Executive Secretary, United States Potash Producers' Association

The outlook for the American potash industry is perhaps clearer than at any time since the armistice. The spring fertilizer mixing season has closed and yet American potash plants are running night and day on contracts in many cases heavy enough to insure continuous operation to the end of this year.

This is a gratifying condition if we compare it with the flat stagnation in the industry at this time in 1919. This condition is due to one fact alone. Europe was able during the early months of 1920 to forward a heavy tonnage of potash to this country. French sylvinite and muriate and German kainit, manure salts and muriate came over by the shipload, but the arrival of this heavy tonnage had practically no effect on prices. Regardless of actual cost to produce and transport, the German and French producers charged every cent they were able to extract from the American market. Some of the German muriate sold at \$3 a unit, while American 80 per cent. muriate, in every respect as good, was selling at \$2.25. German sulphate sold at \$4 a unit all last winter and spring.

German companies, while claiming they have lost money on their domestic business, have paid as high as 20 per cent. in dividends as a result of their 1919 export business to America.

This all means simply that without some effective competition in this country the European producers, French as well as German, will hold up the United States for the last penny that can be extorted. They have no scruples about it; we are rich and they are poor; they have no sentiment about it; business is business. "Make America Pay," is the one idea upon

which all Europeans are agreed, and European potash producers know that during the war American farmers paid as high as \$7 a unit for potash, and they doubtless think they can be made to do it again.

Last year American potash plants stood idle for from six to nine months because our easily beguiled business men really thought that Germany was going to ship us a heavy tonnage of potash and out of the goodness of her heart would charge us only the actual costs of production. This idle dream influenced American business men to refuse American potash plants' contracts and kept them closed until it was too late to supply the demand. As a result they paid \$2.75, \$2.85, \$3 and even \$4 a unit last winter for the German material.

All the large Nebraska plants are in full operation on contracts which will carry them till next November. At Searles Lake one of the companies is shipping high grade muriate East literally by the train load. At Marysville, Utah, the Armour Fertilizer Works is installing improvements to decrease the cost of their product after a very satisfactory year's operation. The Utah-Salduro Company, west of Great Salt Lake, is putting in \$250,000 in extensions of their plant.

The present flourishing condition of the industry does not mean that its troubles are over. The very fact that the European margin between costs and prices charged in America permitted the payment of 20 per cent. dividends despite a loss on their domestic business shows clearly that European producers can utterly swamp the American plants when once they get back to normal production.

Utilization of Low Grade Fuel and Increased Efficiency in Portland Cement Manufacture

A Description of the Lesley Process

As a result of the war the fuel question is almost a paramount one in the American industrial world. Prices for coal have been soaring and the press is filled with accounts of an approaching scarcity of petroleum, with constantly advancing prices for the higher grades of fuel and for industrial oil for the rapidly increasing number of gas engines in operation.

Any discovery tending to ameliorate the conditions stated is likely to be of general benefit and to accomplish important results in industry.

Historical among the important industries where fuel is a prime essential and one whose history is marked by this factor as well as the factor of labor, is that of Portland cement manufacture, which is almost world-wide in its development. In the early days in Europe the great expense in the plants in England, Germany and Belgium was that of handling, storing and drying the wet mix, composed of clay and lime in their various forms. The delay in establishing the American industry was largely caused by the great labor difference between Europe and this country.

In the early '80s the raw material made from argillaceous limestones in the Lehigh district was mixed wet, made into bricks, handled by man power, and dried in large sheds and in drying chambers. The cost was quite large and, in order to obviate this expense and also to improve upon the methods used in Europe, the patents of deSmedt, Willcox and Lesley were used at the works of the American Cement Company at Egypt, Pa., wherein, by the addition of liquid hydro-carbons, such as refinery waste, coal tar—then wasted by the gas companies—and coal pitch, the cement raw material to which these hydro-carbons were added was molded into egg-shaped pieces in fuel briquetting presses and delivered almost immediately from the raw material grinding apparatus to the kiln doors. Great saving in labor and fuel was effected by this process and as a result the American industry rapidly developed. During this period improvements in the old drying floors and in heating the same also enabled other works to increase materially their output.

In 1888 the patents for the Ransome rotary kiln, which had been used experimentally in England for cement making, were acquired by the Atlas Portland Cement Company interests. During the decade between 1890 and 1900 great improvements were made in this kiln. By the substitution of pulverized coal for oil its success as an economical method of burning Portland cement was established and it became practically the type in common use in the United States. In Europe, where coal was dear and labor cheap, a state of facts directly opposite to that which existed in this country, continuous vertical kilns 30 to 40 feet in height were substituted for the old intermittent kilns, similar to the pottery kilns heretofore in use; some American works also introduced kilns of this type.

Since 1900 the rotary kiln has been largely used in Europe, even in face of its greater fuel cost over that of the vertical type.

German Cement Manufacture

At the last meeting of the German Portland Cement Association, held shortly after the armistice, it was found that there were in that country at that time 240

rotary kilns, 88 ring kilns of the old Hoffman type, 243 Dietsch continuous vertical kilns, and 284 Schneider and other vertical kilns. At that meeting Dr. Muller, one of the best known German experts, read a paper profusely illustrated with all types of kilns from the first Portland cement kiln used in England to the last and most modern type of vertical continuous, automatic feeding and discharging kilns now used in Germany. Of the number of stationary kilns above referred to at the time of the reading of Dr. Muller's paper only 48 were of the continuous vertical automatic type, while most of the rest were continuous but required special loading and discharging by hand.

At that meeting, referring to the fuel conditions in Germany and the great advance in prices therein, Dr. Muller gave figures showing that the type of continuous automatic vertical kiln had a coal consumption of about 20 per cent. of the output of cement clinker against an average of 28 per cent. of German production in rotary kilns, and he made the prediction that in ten years all the cement works in Germany will have to be rebuilt to meet the growing prices of fuel.

Increased Efficiency in American Cement Manufacture

This condition in Germany is facing American cement manufacturers, both in the field where pulverized coal is used in rotary kilns, and in the Far Western country where oil is used under similar circumstances.

Having in mind, therefore, the high prices now prevalent for coal and the conditions of the oil industry as already stated, any invention that has for its purpose a saving in the eight or ten million tons of coal that are used annually in the American Portland cement industry, and incidental to this saving the production of large additional supplies of oil and sulphate of ammonia as by-products, is of the greatest interest to cement manufacturers and to the American public.

In a paper recently read before the Association of Portland Cement Manufacturers at their annual meeting in New York, Mr. Robert W. Lesley, a past president of the association and one of the pioneers in the manufacture of Portland cement in this country, described some new inventions recently made by him embodying substantially the purposes above described, and at the same meeting Mr. Spencer B. Newberry, president of the Sandusky Portland Cement Company and one of the leading cement chemists and manufacturers, described a number of experiments made in his laboratory and in his works under the process invented by Mr. Lesley. In the patent mentioned the purpose of the process is described as follows:

There are found in various parts of the world extensive deposits and accumulations of low grade carboniferous material, such, for example, as oil shale, lignite, low grade bituminous and cannel coal and waste or dirty coal in dumps, which contain a considerable percentage of volatile constituents, such as hydro-carbons, ammonia, etc., a considerable percentage of non-volatile or fixed carbon, which is nevertheless combustible, and a large percentage of ash or non-combustible residue. The proportion of the latter constituent is so great that the raw material is incapable of economical use as fuel in its original form or even after subjection to a process of distillation; the pres-

ence and proportion of the ash or non-combustible constituents prevent the coking of the fixed carbon which is mingled with the non-combustible material. The separation of the fixed carbon from the ash or residue is impracticable and thus far there has been disclosed no practicable method of making use of the very substantial percentage of fixed carbon contained in many of such materials.

It is a further fact, however, that the ash or residue, largely of an argillaceous character, is a suitable material for the manufacture of Portland cement in combination with the calcareous or other ingredients. It is the purpose of Mr. Lesley's invention to enable all of the useful constituents of low-grade carboniferous material to be made use of and at the same time to reduce materially the cost of manufacture of Portland cement. In the practice of the invention the low grade carboniferous material is subjected first to a process of distillation by which the volatile constituents, including hydro-carbons, fixed gas, ammonia, etc., are separated from the residue. Then the residue, because of its value as one of the constituents of cement, is subjected to a clinkering process, with heat, generally with the addition of other cement raw material, such as calcareous material, as may be necessary, according to the character of the residue.

In the clinkering process the fixed carbon, which is carried with argillaceous or other material of the residue, constitutes, in the clinkering process, a proportion of the fuel by which the clinkering is effected. Such proportion may be small or large, according to the richness of the carboniferous material, but for most of the materials suggested it will be found that the quantity of fixed carbon in the argillaceous material required is enough to supply nearly all of the fuel required in the clinkering process after combustion has once been established in the kiln; thereby the expense of procuring and preparing fuel for the clinkering of cement raw materials is largely eliminated.

Description of the Lesley Process

In view of the current knowledge of the operation of rotary kilns it will not be necessary to describe fully all the particulars of the patent drawing shown in Fig. 1. It may be stated generally that the raw cement making material is fed in at the upper end of the kilns *a* and *a*¹ at *c* and the hot gases of combustion, instead of going up the stack *g*, as is the usual practice, are, by this process, made to give up their heat in a large meuse to retorts "*d*" and "*d*," which are charged with the low-grade carboniferous material.

It will be observed that the hot gases which escape from the clinkering process are not brought directly into contact with the carboniferous material, but are applied to the same externally, the heat acting through the walls of the retorts to separate the volatile constituents of the carboniferous material from the ash or residue. The waste gases from rotary kilns, as now commonly used in the manufacture of Portland cement, pass off with a temperature of from 1,000 degrees F. to 1,400 degrees F., while the heat required for the distillation of such carboniferous material as that referred to varies from about 800 degrees F. for the lighter oils to about 1,300 degrees F. for the heavier oils. The heat furnished by the waste gases from the kilns is, therefore, usually sufficient to carry on the distillation of such materials.

As a result of this distillation, oil and sulphate of ammonia may be recovered in the ordinary methods known to the art, while the combustible fixed gas, which is evolved in the retorts and has great fuel value, is carried to the lower end of the kiln in any suitable

way (see *e*, *e*¹, *e*², *e*³ and *e*⁴ in Fig. 1) and used, if necessary, in the clinkering process by way of supplement to the fuel derived from other sources. The residue or ash which remains after the process of distillation is generally argillaceous in character and is immediately available for mixture with calcareous material as one of the components of Portland cement.

Suitable means, conventionally illustrated by the conveyor *f*, are provided for conveying ash or residue from the retorts *d* after the distillation is completed, to the hopper *c* from which it is delivered to one or the other of the kilns, after having been mixed on the way with the proper quantity of calcareous material. The place in the procedure of cement manufacture for the extraction of potash, ammonia, etc., from spent gases, is indicated conventionally by *h*.

As this ash or residue carries with it a considerable portion of fixed carbon not volatile or highly volatile and not separated from the residue in the process of distillation, but nevertheless having a high fuel value, it is highly available in cement making when used in the kiln as a fuel therefor.

When combustion by the introduction of fuel from some external source has been availed of, and combustion has once been established, it will be possible to reduce very largely the quantity of fuel supplied from the external source. With many of the kinds of carboniferous material referred to it will be found that the material itself furnishes the greater part of the fuel required in the clinkering operation.

Low Grade Fuels Available for Use

Many experiments have been conducted with the materials described as available under the patent. First and foremost, the field of available fuel material was found to extend almost all over the United States and in fact over most of the civilized world. "Gob piles" containing large quantities of fixed and volatile carbon are numerous in many of the mining regions of the United States; so, too, are waste piles from the washeries of many of the bituminous coal mines in the South. The supply of lignites is extensive in the Far West, while cannelals are found in large bodies in Kentucky, Pennsylvania, Georgia, West Virginia and other states of the Middle West. As for bituminous shale, while attention has lately been fixed upon the immense deposits in Colorado, Utah and Wyoming, it is nevertheless a fact, as shown by reports of the Bureau of Mines, U. S. Geological Survey, and by the State Geologist of Pennsylvania, that available deposits containing large bodies of oil and fixed carbon exist very generally throughout this country, while similar large deposits are found in New Brunswick and in New South Wales, as well as in Esthonia, Roumania, Bulgaria, and many other parts of Europe.

Experimental Applications of the Lesley Process

Analyses were made at the laboratories of Mr. Newberry of many American shales, among them shales from Kentucky and Illinois, which showed oil up to 50 and 70 gallons per ton, while cannelals also were analyzed with equally satisfactory results. In describing these experiments Mr. Newberry, in his discussion of Mr. Lesley's paper, states:

"The idea of taking a fuel high in ash—for example, 35 per cent. or 40 per cent. ash—and distilling that by the waste heat of the kilns, getting the oil and ammonia and gas which they give off, then taking the residue, which will be, perhaps, a mixture of carbon with an equal amount of calcined shale, grinding that in the cement mixture, in this way getting the fuel in the mix

itself, which is needed for the burning—that is a most revolutionary and startling thing, and yet it is, I believe, perfectly practicable."

Results

The results of Mr. Newberry's experiments with cannel shale and other high ash bituminous material, using a 20-foot rotary kiln, were of such an encouraging character as to justify the above comment.

Other experiments were made by Mr. Newberry at the plant of the Sandusky Portland Cement Company at Dixon, Ill., where, in 6-inch iron pipe cylinders 4 inches long, bituminous coal from Benton, Franklin County, Ill., was distilled by the waste gases of the cement kiln at temperatures from 1,300 to 1,400 degrees. The coal lost 35.5 per cent. and produced a coke containing volatile combustible matter 11.8 per cent., fixed carbon 69 per cent., ash 19.2 per cent. The material was very coherent and clean, and suitable for domestic use. In the case of the shales and cannel coal treated the waste was pulverent and contained fixed carbon and silica and alumina fairly well proportioned in the ash. Since then numerous other experiments have been conducted and are now being carried on. The problem of dealing with the "spent shales," which has hitherto been a tremendous expense in the manufacture of oil and sulphate of ammonia from bituminous shale, is completely solved by the use of this spent shale as argillaceous material in the cement mix, and as fixed carbon furnishing fuel in the rotary kiln.

Economics of the Lesley Process

The interesting fact in connection with the process is that it requires no change in the present method of manufacturing Portland cement. It is already well known in the art that a fair saving running from 5 to 10 cents per barrel of cement produced can be made by the installation of waste heat boilers at the rear of the kilns and heating them by the waste gases. In the present case, instead of waste heat boilers, which are used only in half a dozen out of the hundred and odd works in the United States, any suitable form of coal or shale distilling retort is placed in the rear of the kiln and the waste heat gases which go over at temperatures of 1,200 to 1,600 degrees F. are available. The entire distillation process interferes in no wise with present methods of manufacture at existing plants but is simply an addition for the purpose stated. It is also possible that the gases, after use in the distillation of some of the shales and cannels which can be handled at low temperatures, can be carried over to waste heat boilers which may be subsequently installed.

Where bituminous coal is distilled and it is desired to have coke as a by-product, higher temperatures will be required than in the case of shales and cannels.

Tentative figures have been made on a cement plant producing Portland cement in the ordinary way as

against a plant under the new oil and ammonia recovery process. For a plant located at a coal or shale mine, using in round figures 125 tons of coal a day for the kiln as against 375 tons of shale, it is figured that there is an increased gain of 62 cents for this process as against a plant similarly located using the ordinary process. Where a plant of the same type is located 150 miles from the mine and freight must be paid upon the large quantity of shale as against the smaller quantity of coal, an increased gain of about 38 cents is shown for the oil and ammonia recovery process as against the process in present use.

These figures are based upon extremely low prices for oil and ammonium sulphate, the first being figured at 4 cents a gallon and the second at 5 cents per pound,

which are far below the prices obtainable for these products at the present.

Where high grade bituminous coal is distilled and coke is a by-product, and low grade fuel, such as coke breeze, is substituted in the cement mix for the higher grade of furnace coke produced, savings of about 30 cents a barrel are shown, figuring tar and sulphate of ammonia at 5 cents and 6 cents, respectively. The use of gas as a means of burning Portland cement is not new, it having been used for many years in the Iola, Kansas, field for this purpose. Figures showing results of this use as against powdered coal have, as a rule, indicated quite an advantage in B.t.u. values of gas over coal. These figures are likely to be materially improved by the use, in burning the gas that is delivered at the kiln mouth,

of burners of the surface combustion type—a form of apparatus now largely availed of for higher temperature work in many of the great industries of the country, and which, by the proper proportioning of air and gas, shows at high temperatures savings of from 40 to 50 per cent. of normal gas requirements for given industrial heat operations.

The particular advantage of this process in a Portland cement kiln can readily be understood when it is recollected that the entire front end of the kiln is a bed of exothermic refractory material—namely, Portland cement clinker at temperatures around 2,700 degrees F.

At the present time a large number of available materials are under test. Experimental kilns of semi-commercial size are being designed for the distillation of various types of fuel and for the use of the waste material in the cement mix. The by-products, oil and sulphate of ammonia, from this source promise to be a substantial addition to the supplies of these essential materials.

Max Mueller has been elected president of the Rhodia Chemical Co., 135 Cedar St., New York.

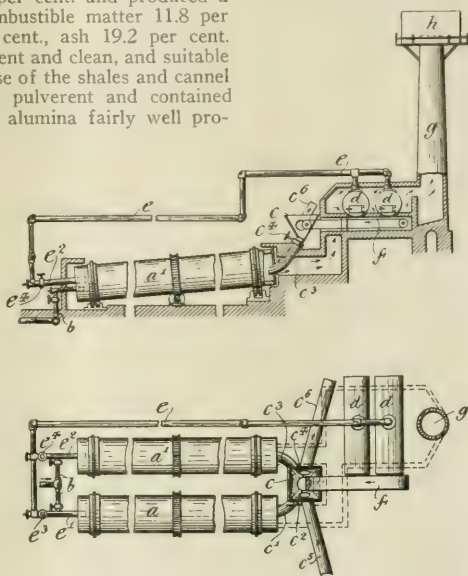


Fig. 1.—Diagram of Lesley Process for Distillation of Bituminous Material by Means of the Heat of Waste Stack Gases of Portland Cement Manufacture.

The Commercial Recovery of Waste Metals

Used paper and rubber are notable instances of chemical products that constitute a dependable source of raw materials for new products and whose collection is a means of livelihood for a large number of people. At no time in industry has there been greater encouragement than the present for the conservation of used material of every kind wherever it is possible to conduct its collection and shipment on a business basis. Household conservation urged so strenuously during the war has been emphasized but little in the post-war era of extravagance. Experience shows that such sporadic collection does not conduce to stability in a scavenger industry whose success depends upon a sustained, steady flow of material which requires that collection, buying, sorting and selling of waste be on a strictly business basis that those engaged in it may make a living.

Secondary Metals

The recovery of metals, as shown in the following table of statistics recently issued by the Geological Survey, is an industry which in its aggregate represents a substantial contribution to our national supply:

	1917		1918	
	Quantity, short tons	Value	Quantity, short tons	Value
Secondary copper, including that in alloys other than brass.....	159,000	\$87,032,400	122,510	\$60,519,900
Remelted brass.....	320,000	141,885,000	328,800	128,696,500
Secondary lead.....	45,100	16,082,000	41,140	13,788,200
Recovered lead in alloys.....	48,400	16,082,000	55,954	13,788,200
Secondary zinc.....	31,400	7,384,800	27,108	6,950,600
Recovered zinc in alloys other than brass.....	4,800	7,384,800	11,082	6,950,600
Secondary tin.....	6,000	23,920,200	7,142	41,381,000
Recovered tin in alloys.....	13,400	23,920,200	16,695	41,381,000
Secondary antimony.....	6	2,061,700	43	1,317,000
Recovered antimony in alloys.....	4,955	2,061,700	5,183	1,317,000
Secondary aluminum.....	9,440	16,711,800	6,050	10,113,600
Recovered aluminum in alloys.....	607	16,711,800	178	10,113,600
Secondary nickel*.....	800	774,000	1,215	1,532,300
Recovered nickel in alloys*				
Total.....		\$295,854,900		\$264,298,900

*Recoveries made by International Nickel Co. from scrap nickel or alloys and from nickel in scrap ferrous alloys from any source are not included.

Copper

The production of copper from secondary sources in 1918 equalled about 29 per cent. of the refinery output of primary copper in the United States from all sources, or about 37 per cent. of the primary copper smelted from domestic ore. The recovered copper was produced by plants refining primary metals and by plants treating only secondary materials. Clean scrap made in the course of manufacture of copper and brass ware, and brass and copper scrap, chiefly from railways, turned into dealers in part payment for new material, constitute the bulk of secondary material.

Lead

The secondary lead recovered in 1918 was 15.2 per cent. of the refined primary lead produced in the United States in that year. A portion of the recovered lead in alloys was derived from old babbitt, solder, type metal, and white metal drosses. The main sources of secondary pig lead are old pipe, lead cable, battery lead and lead lining of acid tanks. It is stated that the manufacturers of toys formerly imported from Europe consume a large quantity of impure and very low-grade lead scrap.

Zinc

The output of secondary zinc (including that in brass) equalled 23 per cent. of primary zinc produc-

tion in the United States in 1918, as compared with 17 per cent. in 1917.

Two smelters in New Jersey, two in New York, and one in California, which treat only zinc drosses and skimmings, use large graphite retorts, of 600 to 800 pounds' capacity instead of the small clay retorts used by smelters treating ore or mixed ore and drosses. The many uses of zinc drosses and skimmings create active competition for their purchase. Considerable zinc is recovered by sweating, and the residues are sold for redistillation. Secondary zinc varies in quality just as the zinc derived from ore does, but a part of the secondary zinc is reported to be of excellent quality.

The urgent demand for scrap steel has resulted in establishing a new industry—that of degalvanizing old zinc-coated scrap so that the steel can be utilized. The zinc coating is removed by the niter cake process and marketed as zinc carbonate or zinc sulphate. It is stated that some of the plants have had difficulty in profitably marketing the zinc compounds produced from the scrap. A large part of the secondary zinc which is not recovered by redistillation is obtained from what is termed zinc dross or galvanizer's dross, which is merely an alloy of iron and zinc that sinks to the bottom of the kettle and is removed from time to time. It is an alloy of zinc with more than 3 per cent. of iron which makes the zinc thick.

This thick zinc is refined by melting it in a kettle, getting it sufficiently hot to be fluid, and then introducing by means of a phosphorizer a crucible material, a small quantity of a mixture of chopped potatoes, sulphur and leather. The dross rises to the top and is skimmed off, and the iron forms a sulphide matter which sinks to the bottom of the kettle. The operation is repeated several times, and the result is that the zinc is purified of the iron. As the zinc is now oxidized, it is deoxidized by the introduction of aluminum, about 1.001 per cent. being sufficient. This method produces an excellent grade of zinc that will run under 0.25 per cent. of iron and will be over 98 per cent. pure.

Tin

The secondary tin recovered in 1918 equalled about 29 per cent. of the tin imported, as metal or as oxide, into the United States in 1918 (82,854 short tons).

Although the United States consumes more than 50 per cent. of the world's tin production, record shows only 105 tons of domestic ore containing 68 tons of metallic tin smelted in the United States in 1918. Nearly all this ore was obtained in Alaska and the remainder in So. Dakota and North Carolina. The American Smelting and Refining Co. imported and smelted tin concentrates from Bolivia at its plant in New Jersey. Tin concentrates from Bolivia also were smelted in electric furnaces by the Andes Electric Co., of N. Y., and some tin also was smelted by the Eastern Metal and Refining Co., of Boston, Mass. The new plant of the Williams Harvey Corp. on Jamaica Bay, Brooklyn, N. Y., was first operated in November, 1918.

Detinning

Nearly all clean tin-plate scrap is detinned by one of three processes—the electrolytic alkali, the chlorine, or the alkali saltpeter.

By the first method the tin is recovered in the form of a spongy granulated precipitate, which can be remelted into pig tin; by the second process tetra-

chloride of tin is recovered for use in silk dyeing and weighting; and by the third process the tin is recovered as an oxide, which is either used as coloring in the enamel industry or is melted into pig tin by means of a reverberatory furnaces.

A patent* has been granted to Daniel A. and Sidney H. Wilcox, of Garden City, N. Y., for a method of separating iron and tin and is based upon the fractional distillation of their chlorides. The scrap to be treated is compressed and heated to a temperature bringing a vigorous reaction when chlorine is passed over the metal, both metals being volatilized as chlorides. The scrap may be melted and the chlorine passed through or over the melted metal contained in a Bessemer converter, reverberatory, cupola, or blast furnace, electric melting furnace, or muffle furnace. By either method the mixed chlorides are separated by fractional condensation and the tin chloride may be converted into metallic tin or tin oxide. The ferric chloride is dissolved in water, reduced to ferrous chloride by passing the solution over hot iron, and electrolyzed, insoluble electrodes being used, so that the products are pure iron (some occluded hydrogen is present, but this may be removed by heat) and chlorine gas, which may again be utilized.

The following table shows the quantity and character of secondary tin material treated in the United States in 1918, together with the quantity and kind of tin products made.

SECONDARY TIN, 1918.

Tin recovered as pig tin.....short tons	7,142
Tin recovered in alloys and chemical compounds	16,695
	23,837
Quantity of clean tin plate scrap treated, including 7,492 long tons imported in 1918 long tons	166,838
Quantity of old tin coated containers treated, long tons	15,000
Quantity of metallic tin recovered at detinning plants	2,220,288
Tin content of tin tetrachloride, tin bichloride, and tin oxide made at detinning plants, pounds	4,365,810
	6,586,098
Quantity of tin oxide, tin bichloride and tin tetrachloride made at detinning plants, pounds	9,771,132
Average recovery of tin per ton from old tin-coated containers	30.56
Average recovery of tin per ton from clean tin plate scrap	36.27

The average recovery, in terms of metallic tin, per ton of clean tin-plate scrap treated in 1918 was 36.27 pounds, and the average recovery from old tin-coated cans was 30.56 pounds. The relatively small quantity of secondary tin recovered from tin plate scrap and old tin-coated cans is significantly shown when compared with the quantity of tin used in making tin plate. It is estimated that 28,000 tons of tin were used by makers of tin plate in 1918, and that the total recovery of tin as metal and in compounds from tin-plate scrap and old cans was 3,293 short tons, and that of this quantity only 228 tons was from old used cans. This shows that considerably less than 1 per cent. of the tin used on old cans was recovered.

More than 99 per cent. of all the old cans utilized in 1918 were treated by the dry chloride process at plants in New Jersey and at East Chicago, Ind., owned by the Metal & Thermit Co. and by the electrolytic process at the Sewaren, N. J., plant of the Vulcan Detinning Co. Most of the cans were re-

ceived from Washington, Philadelphia, New York, Newark, Pittsburgh, Buffalo, Chicago and Rochester, mainly from contractors gathering garbage and waste which was handled by means of picking belts.

The largest user of old cans and scrap tin plate was the Metal & Thermit Co. The efficient plant of this company at Chrome, N. J., consists of separate units for scrap tin plate and for cans. The old cans are dumped directly from the cars into pits, where they are hoisted on conveyors, washed in alkali solutions to remove all paper, paint and dirt, then compressed into oblong billets and placed in steel baskets. The baskets are placed in drums and the tin removed by means of chlorine. The capacity of the plant is increased by treating the cans under pressure, and the recovery of tin is more efficient. Very dirty lacquered or painted cans require a stronger solution to remove the coatings, and occasionally some of the tin is lost in cleaning them. The bundled scrap, after it is detinned, is dried and loaded on cars. This steel scrap can be used by steel plants, as it is practically free from tin. It is compressed into blocks, and in that form the smelting losses are reduced.

New tin-plate clippings were also treated at the above-named plants which treated old cans and also by the Johnson & Jennings Co., Cleveland, Ohio, and the Republic Chemical Co., of Pittsburgh, Pa. The five companies named are the only ones in the United States which reported the detinning of tin-plate scrap or used tin-coated containers, and none of the municipalities which had considered installing plants to utilize metal wastes made any progress, so that it has not been determined whether a detinning plant can be profitably operated by a large municipality, using the combustible part of the city's refuse for power to operate the plant. It is almost certain that a municipality could not profitably treat old cans by the chlorine process, and even if cheap fuel was used to treat the old cans by melting the tin coating, the tin recovered would be small in quantity and of very low grade.

The plants now completed and utilizing old tin cans have never received shipments large enough to operate steadily at capacity even when the prices of tin and black sheet steel scrap were 50 per cent. higher than those prevailing in 1919. The increased cost and scarcity of unskilled labor and the higher cost of cartage and freight have made it unprofitable for collectors of waste material to segregate and ship old cans, so that many contracts with detinning companies were not renewed in 1919. The supply of tin chloride, which is the main product of detinning plants, is ample since war uses have ceased—in fact, a considerable quantity of tin tetrachloride has been reclaimed from hand grenades. The tetrachloride was used in grenades to cause a dense white fume when the grenades were thrown and broken.

The detinning plants treating old cans can handle more than 25,000 tons of cans a year, but it is very doubtful if the consumption in 1919 will be more than 40 per cent. of that capacity. The supply of used cans has been steadily decreasing as contracts expire, and this will necessitate the closing of several plants, for the margin of profit is small, and steady operation is required to make any profit.

Old tin cans do not sell for more than \$9 to \$11 a long ton delivered at detinning plants, and thus they bring the shipper only \$4 to \$5 a long ton after loading and freight charges are paid. Contractors for refuse find it impossible to make any profit after paying the advanced costs of labor to sort and ship the tin cans. The only feasible method of obtaining

*U. S. Patent 1310381, July 15, 1919.

a steady supply of cans is by a reduction in the cost of handling. This can be effected by municipal laws requiring clean rustless cans to be segregated by the householder and dumped by the collector directly into cars or into a baling machine. Unless the cost of common labor decreases materially or the methods of collecting the cans are changed, there will be a large decrease in the quantity of tin and steel recovered from used containers. Conditions are most unfavorable for the collection and utilization of used tin cans, and their bright glow and gaudy labels will continue to make more conspicuous the dumps of garbage and scrap that disfigure the outskirts of cities and towns.

The collection of tin-foil and old collapsible tubes largely by persons and organizations for charitable purposes has also become less effective, because much of the foil and many other containers are not now made from tin or contain only a small quantity of tin. Small quantities of foil made from lead, zinc, or aluminum are not of much value and do not pay for the trouble of saving and selling. Considerable quantities of block-tin pipe were used in saloons, and the abolition of the liquor business renders available considerable tin from the scrapping of bar fixtures. Probably not more than 1,000 tons of tin was derived in 1918 from all the old tin pipe, collapsible tubes, and tin-foil marketed.

Although there is now a supply of tin sufficient for all requirements, there are two good reasons for restricting its use to the lowest point. One is that the supply of new tin is derived almost entirely from foreign sources, and the other is that tin is a relatively high-priced metal and the use of substitutes giving approximately equal efficiency radically reduces the cost of many alloys, such as solder, babbitt, and other bearing metals.

Aluminum

The recovery of secondary aluminum as pig aluminum or in alloys in 1918 amounted to 15,050 tons, valued at \$10,113,600, as compared with 16,100 tons, valued at \$16,711,800, in 1917. The quantity recovered in alloys amounted to 9,000 tons.

Some of the larger secondary smelters and refiners of aluminum in 1918 were the Peninsular Smelting Co., Detroit, Mich.; United Smelting & Aluminum Co., New Haven, Conn.; United States Reduction Co., East Chicago, Ind.; Great Western Smelting & Refining Co., Chicago, Ill.; Cleveland Electro Metals Co., Cleveland, Ohio; W. F. Jobbins Co. (Inc.), Aurora, Ill.; Progressive Metal & Refining Co., Milwaukee, Wis.

Various products are made by smelters and refiners from scrap aluminum. One sample of pig aluminum, which was made from clean sheet-aluminum clippings, shows the following analysis:

ANALYSIS OF SECONDARY ALUMINUM.	
Aluminum	98.75
Copper	.16
Silica	.11
Iron	.56
Manganese	.42
	100.00

The standard No. 12 alloy is the best known and most widely used of aluminum casting alloys. It contains a minimum of 92 per cent. aluminum and from 7 to 8 per cent. copper. Another alloy made by a large secondary aluminum smelter contains 4 per cent. zinc, 8 per cent. copper, and the remainder aluminum.

Aluminum chips from castings used in the manufacture of automobiles have become a large source

of secondary aluminum. By the old methods of treatment the loss in remelting such chips was sometimes as much as 40 per cent.

On account of the difficulty in obtaining virgin pig aluminum, a considerable quantity of scrap aluminum was purchased directly by foundries instead of being purchased and refined by secondary smelters.

Nickel

An effort was made for the first time in 1916 to ascertain the quantity of secondary nickel recovered as nickel or in alloys. The reports received in 1918 showed that 1,393 tons of nickel was recovered in that year, a considerable part of which was obtained from clean, new scrap. This does not include any nickel in scrap ferrous alloys nor the monel metal recovered from secondary sources made by the International Nickel Co. The monel scrap remelted by the International Nickel Co. is included with matte and ore, and no separate recovery is attempted. The quantity of nickel in matte oxide and in ore imported into the United States in 1918 was 73,207,147 pounds, most of which was from the Sudbury district, in Ontario. The nickel-copper matte imported is partly refined and partly smelted to make monel metal. Of the refined nickel produced about 60 per cent. is used in nickel steel, 30 per cent. in white metal alloys, 5 per cent. in anodes for plating, and 5 per cent. for miscellaneous purposes, including the manufacture of salts and other chemical compounds. No direct production of nickel from American nickel ores is known to have been made in the United States in recent years, but an equivalent of about 441 short tons of nickel was saved in 1918 as a by-product in the electrolytic refining of copper.

The Missouri Cobalt Co., of Fredericktown, Mo., mined ore in 1918 which contained lead, copper, nickel and cobalt. A new refinery was completed at which the residues returned from the ore shipped to sulphuric acid plants are treated for the nickel and cobalt content.

As the greatest use for nickel is as an alloy in steel, and the secondary recoveries of nickel reported to the Geological Survey in 1918 were obtained solely from nonferrous scrap, it is evident that the 1,393 tons of nickel reported form a small portion only of the nickel in alloys recovered and reused. The secondary nickel reported in 1918 was nearly all recovered from old nickel anodes, nickel silver, and monel metal.

J. T. Strachan, formerly chief chemist of the Canada Paper Co., is now assistant superintendent of the Bogalusa Paper Co., Inc., Bogalusa, La.

* * *

F. W. Willard of the Western Electric Co.'s Hawthorne, Chicago, plant, is in charge of the company's construction of a trans-oceanic cable plant to be built on a 50-acre site opposite the Navy Yard at Norfolk, Va.

* * *

Conrad E. Thies, formerly with the Palo Co., is now with the Rohde Laboratory Supply Co., New York City.

* * *

Foster A. Burningham, formerly at the Pittsburgh station of the Bureau of Mines, is now a research chemist with the Brown Co., Berlin, N. H.

* * *

C. J. Haines, formerly with the American Cotton Oil Co. at the Chicago refinery, is now plant superintendent of the Electro Co., Peoria, Ill.

Notes of the Manufacture of Nitro-Cellulose

By J. O. Small and C. A. Higgins

Hercules Powder Company

A great deal has been written from time to time on the theoretical aspects of the nitration of cellulose. Here are given a few comments from the manufacturing standpoint on some of the more important phases of the preparation of nitro-cellulose for use in the non-explosive arts.

Roughly, one-third of the cost of manufacture of nitro-cellulose is represented by the acid consumed or lost in nitration. When it is realized that only about one-half of this acid cost represents acid actually consumed in the chemical reaction, it becomes evident that here is a fruitful field for study and endeavor in the effort to reduce costs. Acid consumed or lost may be divided into two classes: (1) chemical; (2) mechanical.

Chemical Losses

By chemical loss is meant the acid consumed in actual chemical combination with the cellulose. The quantity of acid thus consumed varies according to the desired nitrogen content of the nitro-cellulose. For instance, in manufacturing one hundred pounds of nitro-cellulose with a nitrogen content of 10.7 per cent., such as as commonly used in the celluloid industry, 48.15 pounds of nitric acid are consumed as nitrogen; again, one hundred pounds of nitro-cellulose with a nitrogen content of 12.0 per cent., as used for pyroxylin solutions, require the consumption of 54.0 pounds of nitric acid as nitrogen.

Mechanical Losses

All other losses of acid we designate as mechanical losses, the most important one of which is the quantity of acid retained in the nitrocellulose after wringing. This is influenced by several factors, the most important of which are the nitrogen content, the physical condition of the cotton fibre, and the manner of wringing. The following table gives some factory scale results compiled from the manufacture of 16 lots of nitrocellulose with nitrogen contents, varying from 10.52 per cent. to 13.30 per cent. and with acid retentions varying from 166 to 53.8 pounds of acid per 100 pounds of nitro-cotton. The composition of the nitrating acid used for each lot is also included.

TABLE I.—TABULATION OF RESULTS OF FACTORY NITRATION.

No.	Composition of Nitrating Acid—					Lbs. Acid Retained		
	Nitrogen	HNO ₃	H ₂ SO ₄	HNO ₃ O ₂	H ₂ O	per 100 lbs.		
	per cent.	per cent.	per cent.	per cent.	per cent.	HNO ₃	H ₂ SO ₄	Total
1.....	10.52	22.30	51.97	5.25	20.48	62.0	104.0	166.0
2.....	10.74	22.08	52.50	5.10	20.32	53.4	79.2	132.6
3.....	10.86	21.60	53.13	4.80	20.47	47.4	77.8	125.2
4.....	10.96	22.13	51.99	5.60	20.28	44.4	64.8	109.2
5.....	11.05	22.86	51.24	5.17	19.73	44.2	64.6	108.8
6.....	11.10	22.74	52.04	5.57	19.65	41.1	62.9	104.0
7.....	11.14	24.81	53.60	1.37	20.22	41.2	54.0	95.2
8.....	11.19	23.80	50.40	6.55	19.25	51.2	39.6	90.8
9.....	11.91	20.18	55.93	6.00	17.80	30.0	50.9	80.9
10.....	11.92	20.15	55.80	6.20	17.85	27.6	54.2	81.8
11.....	11.96	20.30	56.13	5.80	17.77	27.2	54.0	81.2
12.....	11.98	19.98	55.95	6.25	17.82	28.4	51.6	80.0
13.....	12.06	20.50	55.45	6.40	17.65	25.8	51.8	77.6
14.....	12.75	19.54	60.92	4.57	14.97	23.2	68.2	91.4
15.....	13.00	20.00	59.64	5.30	14.16	23.2	38.4	61.6
16.....	13.30	24.37	59.54	4.86	11.23	14.4	39.4	53.8

From Table I there appears to be a direct relation between the total quantity of acid retained in the nitrocellulose after wringing and the nitrogen content. In the majority of instances there is the same relation as far as the quantity of nitric acid retained is concerned. One possible explanation of this is that nitro-celluloses of lower nitrogen content are of a softer texture and are more gelatinous than those with higher nitrogen content, and, therefore, under the same con-

ditions would retain more acid. Upon comparing costs between nitro-celluloses of typical nitrogen contents, such as the 12.0 per cent. as used for pyroxylin solutions, and the 10.7 per cent. as used in the celluloid industry, we find by basing our calculations upon the data given above that it would be more economical to manufacture a nitro-cellulose of 12 per cent. nitrogen than one of 10.7 per cent., provided that their respective acid retentions were to remain in the same relation as that shown above. By basing our calculations only on the quantity of nitric acid retained, we get the following figures:

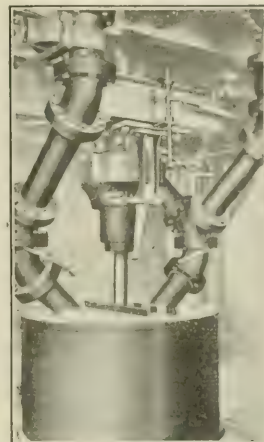


FIG. 1.—WRINGER FOR SEPARATION OF NITRATING ACIDS FROM NITRO-CELLULOSE.

After the cellulose of cotton fibre is converted into nitro-cellulose in the "dipping pots" the mass is discharged into the wringer, directly below. Here the acids are separated centrifugally.

Nitrogen.	Lbs. nitric acid consumed per 100 lbs. nitro-cellulose	Lbs. nitric acid retained per 100 lbs. nitro-cellulose.
10.7	48.15	53.4
12.0	54.0	28.4

Difference in favor of 12.0 per cent. nitrogen as per acid retained	25.0
(Pounds nitric acid per 100 pounds nitro-cellulose)	
Difference in favor of 10.7 per cent. nitrogen as per acid consumed	5.85
(Pounds nitric acid per 100 pounds nitro-cellulose)	

Net difference 19.15

Therefore, with nitric acid at eight cents per pound, one hundred pounds of nitro-cellulose of 12 per cent. nitrogen could be manufactured for \$1.53 less in acid cost than could the same quantity of nitro-cellulose with a nitrogen of 10.7 per cent.

Influence of Physical Condition of Fibre and Operating Methods on Acid Retention

The physical condition of the fibre of the cotton influences acid retention in that a "pilled fibre" causes a smaller quantity of acid to be retained in the nitro-cellulose than does a "matted" fibre, due principally to the fact that the latter type packs so closely in the wringer basket as to prevent the removal of the acid. Instances have been recorded where this difference in the cotton fibre caused a difference in acid retention of ten pounds of nitric acid per one hundred pounds of nitro-cellulose, all other factors being equal.

The manner in which the nitro-cellulose is centrifuged, taking into consideration the speed of the wringers, the size of the perforations in the wringer baskets, and the time of wringing, also affects the acid retention. One interesting feature observed in the wringing of nitro-cellulose is that at the beginning of the operation the acid removed is ordinary spent acid in which the ratio of sulphuric to nitric is approximately three to one; but as the operation continues the percentage of sulphuric in the acid being removed increases until the ratio of sulphuric to nitric in the acid remaining in the nitro-cellulose is less than two to one. This relation of nitric to sulphuric in the acid retained by the nitro-cellulose is shown more clearly in Table I.

Considering more in detail the effect which the method of wringing has upon the quantity of acid retained in the nitro-cellulose, we find that there are at least four factors having an important bearing upon this question. The peripheral speed of the wringer is probably the most important of these, and where variations in the speed occur, a corresponding variation may be observed in the acid retention. The time of wringing should be controlled by the type of nitro-cellulose being manufactured, the chief object being to continue the time of wringing until the value of acid removed ceases to counteract the increased labor cost due to the decreased production. The size and smoothness of the perforations in the wringer basket also affect acid retention, since if the holes are too small it prevents the removal of the usual quantities of acid, while if too large a loss of nitro-cellulose results. When these perforations are rough, small particles of nitro-cellulose will adhere to them, and in a comparatively short time will produce the same effect as though these perforations were too small.

There is also a source of acid losses in the wringer which is peculiar to the mechanical dipper system of nitration. When the charge of acid and nitro-cellulose is dropped from the nitrating pots into the wringers, imperfect seating of the bottom discharge plate will allow acid to be lost in the "drowning" basin below.

Nitric Lost as Fumes

Second in importance only to acid retention as a loss of acid, is the quantity of nitric acid lost by fumes. This is a problem common to all engaged in the manufacture of nitro-cellulose with the possible exception of those using the Thomson displacement process. The importance of this problem may be better understood when it is realized that the quantity of acid contained in the fumes formed during the manufacture of low viscosity nitro-cellulose with a nitrogen content of twelve per cent. amounts to approximately twenty-five pounds of nitric acid per one hundred pounds of nitro-cellulose, or roughly a loss of two cents per pound of finished product.

In making a survey of the fume recovery proposition, the foremost consideration should be the health of the operators. Continued exposure to acid fumes is frequently a cause of serious lung trouble, and, therefore, the first object should be to remove as much of the fumes as possible from the immediate vicinity of the operators. How thoroughly this can be accomplished is illustrated in Figure 2, wherein an operator is shown in the act of adding the cotton to the nitrating bath. Masks or other protective devices are not needed, since the fumes are removed from the house by suction. However, in removing fumes in such a satisfactory manner, the volume of gases from which the nitric acid is to be recovered is made large

and the velocity of such gases or fumes is high.

Factors Affecting Fume Losses

The quantity of fumes formed is controlled chiefly by four factors—temperature of nitration, manner of agitation, kind of cotton used and quantity of nitric in the nitrating acid. Higher temperatures of nitration cause an increase in the vapor tension of the nitric acid, which in turn increases the quantity of fumes formed. If the period of agitation is too short, the cotton will begin to fire, thus increasing perceptibly the fume loss. The

type of cotton influences fume losses in that cotton, which has not been well opened before nitrating, will cause the formation of a larger quantity of fumes. Moisture in the cotton is also a factor, since it raises the temperature by the action of the water with the sulphuric acid. Nitrating acids with higher percentage of nitric acid will cause the formation of more fumes than will acids with lower percentages of nitric acid.

Several methods are in use for the recovery of nitric acid from fumes, generally depending upon either the condensation of the gases or their absorption. The latter method is probably more generally used. When using the absorption method the chief object should be to obtain the finest atomization possible of the absorbing liquid, and in this connection it might be mentioned that the problem of obtaining a spray nozzle, which will withstand the warm acid fumes, and which will deliver a very fine spray, is a difficult one.

Cellulose

The careful manufacturer with the question of cost constantly before him is confronted with the fact that cellulose in its commonly accepted forms ranges at this time from about six cents per pound for hull fibre, to around twenty-five cents per pound for the highest grades of first-cut linters or the high grade tissue paper, as used by celluloid manufacturers. Hull fibre or shavings are used principally for nitro-cellulose for smokeless powder, and in this connection we might mention that the Thomson displacement process of nitrating gives the highest chemical yields from this grade of cellulose. Second and third-cut linters are used principally for nitro-cellulose for the leather cloth and allied industries, while for high grade lacquers and for celluloid, only the first cut, long fibre cotton or the best grade of tissue paper are used. In selecting a cellulose for nitrating attention should be given to both its chemical and physical properties, since both have considerable effect upon the economy obtained during the nitrating process.

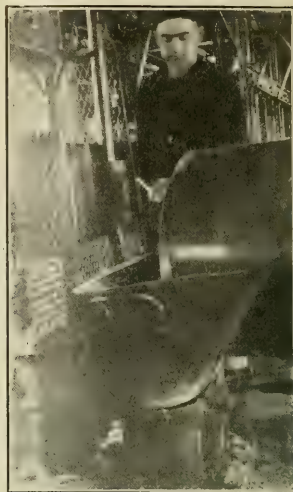


FIG. 2.—THE NITRATION OF COTTON

The operator, without mask, is charging with cotton a dipping pot containing the nitrating acids, the evolved nitrous gases being removed by suction.



FIG. 3.—PURIFICATION OF NITRO-CELLULOSE.

View of the "boiling tubs," wherein preliminary treatment is effected.

Factors Influencing the Chemical Properties of Cellulose

As factors influencing the chemical properties of the cellulose, the biological character of the crude fibre and the method in which the crude fibre is purified are of the greatest importance. As is well known, the cotton plant produces a great variety of cellulose, of widely different degrees of complexity, depending upon the species of the plant and conditions under which it grows. The complexity of the cellulose molecule increases as the ripening process proceeds, but since all bolls do not begin to ripen at the same time it is evident that there will be at all times a certain amount of immature cellulose present. The least matured of these molecules contain the greatest amount of pectins and hemi-celluloses and vice versa.

During the purification of the crude fibre, four factors have a very important bearing upon the suitability of the purified fibre for nitrating purposes. The first two are the temperature (steam pressure) and time of digestion. When the temperature is high and the time of digestion excessive, it produces an effect which is the opposite of the ripening process; e. g.; decreases the molecular complexity. The next point is the strength of the caustic solution used in digestion. It has been observed that the solubility in strong caustic solution decreases with increased molecular complexity, and therefore, digestion with strong caustic solution, by removing the more immature portions, increases the average complexity of the charge. Probably one of the worst effects from improper purification is due to overbleaching, since it causes the formation of oxy-cellulose. This compound when nitrated gives a low yield, and the nitrated oxy-cellulose thus formed, since it is soluble in alcohol, causes greater losses in dehydration.

Influence of Physical Properties of Cellulose

Physical properties are of greater importance to manufacturers of nitro-cellulose for the non-explosive arts than to those engaged solely in the manufacture of nitro-cellulose for explosives, since questions of cleanliness and color are of the most importance to the former, but do not have any considerable influence upon the latter. The most important physical characteristics are cleanliness, color and the extent to which the fibre has been compressed. The first two factors need no discussion, since it is readily conceivable what effect these have in such lines as celluloid and high grade lacquers. Among the ordinary run of cotton linters today, there are two types of fibre which have often been referred to as "pilled" and "matted," respectively. The former is well opened and when immersed in acid is more readily

penetrated, thus giving a more uniform nitration. Another advantage which a fibre of this type offers is that the quantity of acid retained after wringing is lower than for the "matted" type.

Interpretation of Chemical Tests of Cellulose

From a chemical standpoint, the solubility of the linters in sodium or potassium hydroxide, the furfural value, and the ether extractive matter, are of most importance, since they are indicators not only of the manner in which the linters were purified but also give a fairly accurate idea of what difficulties may be expected during the nitration and purification of the nitro-cellulose. For instance, the portion soluble in sodium or potassium hydroxide consists of what are commonly called "compound celluloses," frequently oxy-cellulose, and, as has been previously mentioned, denotes excessive bleaching treatment. When oxy-cellulose is present to any considerable extent, it can be expected that when nitrating the yield will be low and that if the nitration is conducted at high temperatures, considerable portion of the nitrated products will be dissolved in the acid. The furfural content is largely an indication of the maturity of the fibre, the more immature fibres having the higher furfural values. High furfural values are often an indication that complete stability of the resultant nitro-cellulose will be difficult to obtain. The ether extractive matter denotes that portion of the original crude fibre which was not properly treated with caustic soda during the digestion process. Aside from causing low yields and slightly higher consumption of nitric acid, linters with considerable ether extractive matter often cause fires to occur during the nitrating process.

After having assured himself of the most important chemical properties, the careful manufacturer will then examine the linters for cleanliness, color and length of fibre, the latter point being one of considerable importance to those who use the mechanical dipper process of nitration. One fact that should also be borne in mind is that because of very non-uniform character of the cellulose molecule, practically all forms of cellulose available today for nitration exhibit a great variety of physical and chemical properties. It is only by more careful control of the factors influencing these properties that many of the complicated problems arising in connection with the manufacture of nitro-cellulose will be solved.

Stability and Purification

The importance of thorough stabilization is not always appreciated by users of nitro-cellulose in the non-explosive arts. In the manufacture of nitro-cellulose for explosives and propellants, the question of stability is one of prime importance, due largely to the fact that the material is generally stored for a considerable length of time, and hence elaborate precautions are taken to obtain a maximum stability. Military specifications are that the nitro-cellulose shall stand the 65.5°C. heat test with potassium iodide starch paper for 45 minutes, and the German test at 135°C. for 30 minutes. This is accomplished by a purification treatment similar to the following:

A preliminary treatment of one sixteen-hour boil followed by three boils of eight hours each, with not less than four changes of water during the treatment. This treatment is given in tubs known as "boiling tubs," a typical view of which is shown in figure 3. This is followed by a final treatment of twelve hours of boiling with five changes of water, which is usually given as follows: One six-hour boil; one two-hour boil; four one-hour boils. This is com-



FIG. 4.—PURIFICATION OF NITRO-CELLULOSE.

View of the "poaching tubs," wherein final treatment is given.

monly called the "poaching" treatment and is given in tubs called "poacher tubs," which are fitted with mechanical agitators. Figure 4 shows an up-to-date poacher house installation.

Complete stabilization can be had only when the nitro-cellulose is pulped, since the cotton fibre, both before and after nitration, is in the form of a tube, and unless this is broken open, it is impossible to remove, by washing and boiling, the last traces of acid which remain in the capillary. Figure 5 shows one type of beater or pulper used for breaking open the nitro-cellulose fibres. This type, known as the "Jordan engine," is particularly valuable for grades of nitro-cellulose which must be pulped both finely and uniformly. Another important factor in stabilization is alcohol dehydration, which removes by solution the lower nitrated and more unstable types, especially those compounds formed by the nitration of oxy-cellulose, which may have been present before nitration. By removal of these lower nitrated types, we decrease the so-called "granularity" which is often found in pyroxylin solutions. Since nitro-cellulose for the non-explosive arts contains a larger percentage of the very low nitrated types, it is evident that alcohol dehydration in its stabilizing effect is even more important for this class of nitro-cellulose than for explosives and propellants.

Results of Instability

The most common effects of unstable nitro-cellulose in the non-explosive arts are the formation of a brittle film, the discoloration of dyes and corrosion in metal lacquers. In leather cloth, a brittle film will cause the coatings to crack and peel off, and in industries where dyes are added to nitro-cellulose solutions, acid liberated by the decomposition of unstable nitro-cellulose will cause a considerable discoloration of such dyes. When lacquers are applied to certain metals, instability causes corrosion of the metal which has been coated. Finally in the celluloid industry, it is possible that unstable nitro-cellulose causes a discoloration of the finished product, but great improvements in the stability of such material have recently been made.

The general opinion concerning the stability of nitro-cellulose for the non-explosive arts seem to be that thorough stability can be obtained only at the expense of solubility and clearness of the solution. While it is true that nitro-cellulose, if boiled for a considerable period in water which is either acid or neutral in reaction, will give a more opaque solution than

will nitro-cellulose which has received a very short purification treatment, it is quite possible that the clearness of the solution in the former case would not be impaired were the acid and neutral treatments followed by an alkaline treatment. It has been our experience that alkaline treatments in general have a tendency to increase the clearness and brilliancy of nitro-cellulose solutions, even after the nitro-cellulose has received acid and neutral boils of considerable duration, prior to the alkaline treatment. This being the case, it is evident that one of the objectionable features previously mentioned in connection with a thoroughly stabilized nitro-cellulose can be eliminated. As far as solubility is concerned, we have found practically no difference between the solubility of nitro-cellulose which had been boiled from five to six days and that which had been boiled for only one day.

It is possible that some of the advantages which would result from the use of a better stabilized nitro-cellulose in the non-explosive arts have been overlooked, and there is also the possibility that some of the difficulties encountered in such industries may be caused by instability. In our opinion it is a matter worthy of careful consideration by all users of "non-explosive nitro-cellulose."

The Relation of Viscosity to Cost of Nitro-Cellulose

There seems to be an increasing tendency on the part of users of soluble cotton toward very low viscosity types, the object being to deposit the maximum amount of solids with the minimum quantity of solvents. Since it does not appear to be generally realized that a diminution in the viscosity factor means an increase in cost of the finished product, we will touch upon the principal manufacturing factors influencing the cost of nitro-cellulose, as affected by the viscosity.

The principal cost factors directly related to the viscosity of nitro-cellulose are: (1) yield; (2) loss of acid by fumes; (3) acid loss in wringing; and (4) contamination of acid with dissolved cellulosic bodies.

The chief factor affecting the viscosity of nitro-cellulose is the temperature of nitration; the higher the temperature, the lower the viscosity of the finished product, other factors remaining unchanged. Since practically all non-explosive nitro-cellulose is nitrated at comparatively high temperature, it is evident that a difference of a few degrees in the temperature of the acid will have a pronounced effect upon the factors enumerated above. With an excessively high temperature of nitration the hydrolyzing action of the sulphuric acid in the nitrating bath is increased and at some temperatures even the nitrated products themselves are hydrolyzed, causing the solution of a considerable portion in the acid.

Temperature changes also affect the vapor tension of the nitric acid and with the increase in vapor tension, the loss by fumes increases. When much of the cellulose has been hydrolyzed the nitrated charge is in a semi-gelatinous condition, thus preventing the removal of the usual quantities of acid in wringing. High temperatures cause more cellulosic bodies to be dissolved in the acid, and this involves losses of two kinds, viz., (1) the cellulosic bodies themselves are incapable of recovery, and (2) when these are removed, an acid loss is sustained due to the retention in such bodies. Higher temperatures of nitration

cause the resultant nitro-cellulose to be in a more finely divided condition, thus entailing losses through the perforations both of the wringer baskets and the purification tubs.

It should be borne in mind that a decrease in viscosity involves a decrease in the strength of the resultant film or coating. The greatest possible strength is required in nitro-cellulose coatings for leather cloth, and in view of the fact that modern solvent recovery equipment has reduced solvent losses to a minimum, it is possible that an extensive use of the very low viscosity types is not well advised.

Uniformity of Product

The facility with which nitro-cellulose may be used in the non-explosive arts depends largely upon its uniformity, and in order to insure such uniformity of finished product, the following factors should be carefully controlled: (1) viscosity; (2) strength of film; (3) nitrogen content, and (4) color and appearance of solution.

In the leather cloth trade, a change in viscosity may require the addition of one or more extra coatings to the cloth, while in the use of metal lacquers its effect is even more pronounced. If the viscosity is too high, the coating will be too heavy and will peel off easily, while if too low, the surface of the metal will not be evenly covered and will produce the effect known as "iridescence." In the leather cloth and allied industries strength of film is of great importance. Incorrect nitrogen content causes difficulties of two kinds. In the first place, if the nitrogen is too high, the nitro-cellulose will be insoluble in the solvents used and particles of undissolved nitro-cellulose will remain; again when the nitrogen content is too low we get the effect known as granularity. The nitrogen content of any nitro-cellulose is the average nitrogen content of all the molecules, which vary considerably in their complexity. This may be readily determined by selective extraction with solvents. A practical illustration of this is seen in the nitro-cellulose extracted by the alcohol used in the dehydration process. For example, the quantity of nitro-cellulose dissolved by alcohol of 92.5 per cent. strength used in the dehydration of nitro-cellulose of about 12 per cent. nitrogen, shows that about one-half of one per cent. is removed in this manner.

The color of the nitro-cellulose should be uniform, since in those industries where dyes are used to neutralize certain objectionable colors, material not uniform in this respect necessitates changes in the color formulae used, as for example in the manufacture of pyroxylin plastics. Finally the general appearance of the solution of nitro-cellulose as regards opaqueness and the ability of the solute to remain in solution, is extremely important.

Conditions Affecting Viscosity

The following factors affect viscosity of nitro-cellulose:

I. The relation of nitric to sulphuric in the nitrating acid; increased nitric acid will increase the viscosity, but there is no direct relation between the nitrogen content and the viscosity.

II. Temperature, which in the method most generally used, has been mentioned previously.

III. The ratio of acid to cotton; the greater the proportion of acid to cotton, the higher will be the

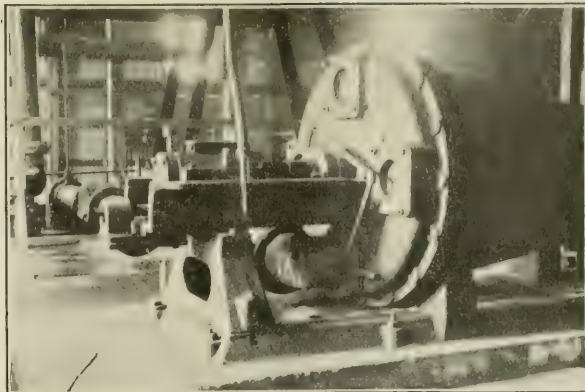


FIG. 5.—THE JORDON ENGINE.

Used to effect complete disintegration of the tube-shaped nitrated fibre, whereby the structure is broken down to a pulp, permitting complete removal of the last traces of acid, essential to stabilization.

viscosity. This holds true for ratios varying from 30 to 1 to 80 to 1.

IV. Time. When the nitrating operation is prolonged, it decreases the viscosity.

V. Type of cotton. Affected by its maturity, the severity of its purification (digestion) and the degree of bleaching. The more prolonged the digestion and the more bleaching it receives, the lower will be the viscosity of the nitrated product.

VI. Duration of the purification treatment of the nitro-cellulose; the more boiling it receives, the lower will be the viscosity.

VII. Nitrosyl content of the nitrating acid affects viscosity in that the higher the nitrosyl the lower will be the viscosity.

The strength of the film, which may be deposited from a solution of nitro-cellulose, is dependent probably more upon the viscosity of the nitro-cellulose than upon any other factor, and hence is influenced more or less by the same factors previously mentioned as controlling viscosity. The length of the fibre of the nitro-cellulose is another property affecting the strength of the film, and is dependent upon the length of fibre of the cellulose and upon the severity of the purification treatment given the nitro-cellulose.

Conditions Affecting Nitrogen Content

The nitrogen content is influenced as follows:

I. Composition of nitrating acid. As the vapor tension of the nitric acid is increased, the degree of nitration will be increased. This in turn is dependent upon the "dehydrating value" of the sulphuric acid.

II. Ratio of acid to cotton. The more acid there is in proportion to the quantity of cotton present, the higher will be the degree of nitration.

III. Temperature. Increasing the temperature increases the nitrogen content partly because of the fact that the vapor tension of the nitric acid is thereby increased.

IV. Agitation. The method of agitation used influences to a great extent the uniformity of nitration. It has been found that under identical conditions, there is a difference of nearly 0.2 per cent. in the nitrogen content as between material thoroughly agitated during nitration and that which received no agitation.

V. The quantity of moisture present in the cotton at the time of nitration is of greater importance in controlling the nitrogen content than is generally

believed. In estimating this effect, it is incorrect to base it upon the entire weight of the acid used, since only the acid absorbed by the cotton should be taken into account. Roughly, cotton absorbs about three times its weight of acid, and hence, a difference of one per cent. in moisture content of the cotton would increase the water content of the acid about 0.33 per cent.

Conditions Affecting Color

The color of the nitro-cellulose and the appearance of its solution are problems peculiar to the non-explosive arts, and are of more importance when the material is to be used in the manufacture of high grade lacquers or celluloid than when used for leather cloth. The ultimate aim of industries of the former class is to obtain a nitro-cellulose solution which will

be "water-white" and hence our employment of the term "color" signified the *presence* of color in such solutions. An inferior color may be caused by the use of an insufficiently matured cellulose for nitration, or by the introduction of iron during the purification of the nitro-cellulose. The manufacture of nitro-cellulose, the color of which shall be suitable, for instance, for first-class transparent celluloid sheets requires strict attention to the iron content of the water used in purification, to the amount of ferrous equipment in use, and to the manner of bleaching.

Because of the many factors controlling the condition of the finished product, even after due and careful attention has been paid to all of them, a consistently uniform product can be obtained only by blending large batches after the nitration and purification processes are completed.

National Research Council Receives Endowment

The National Research Council, the co-operative organization of scientific and technical men of the country for the promotion of scientific research and the application and dissemination of scientific knowledge for the benefit of the national welfare, has received an endowment of \$5,000,000 from the Carnegie Corporation, part of which is to be expended for the erection of a suitable building in Washington for the joint use of the council and the National Academy of Sciences. Other gifts have been made to it for the carrying out of specific scientific researches under its direction. The Council was organized in 1916 under the auspices of the National Academy of Sciences to mobilize the scientific resources of America for work on war problems, and reorganized in 1918 by an executive order of the President on a permanent peace time basis. Although co-operating with various Government scientific bureaus, it is not controlled or supported by the Government.

Canadian Experience in Government Operation of Fertilizer Plant

The Dominion's fish reduction works at Clark's Harbor, Nova Scotia has been discontinued and sold by public tender by the Department of Marine and Fisheries, acting on reports by responsible officials of that department.

The original cost of the plant was \$36,062.93, and the cost of maintaining and operation, \$89,908.22. The proceeds from the sale of produce of this plant, which cost the Government \$125,871.14, was \$19,706.93.

The Department of Marine and Fisheries denied all knowledge of a report by J. B. Fielding, of the Advisory Council of Scientific Research, to the effect that the plant was worth retaining for the manufacture of fertilizers, though useless for the production of food. Mr. Fielding found the works badly cared for but in working condition.

Professor Charles Baskerville, of the College of the City of New York, in recognition of his investigations on inhalation anesthetics, has been elected a member of the research committee of the National Anesthesia Research Society.

John J. White has disposed of his interests in the Rhodia Chemical Company, of New York, owing to press of other business, and the policies of the company will no longer be directed by him.

Personal Items

W. B. Hicks, formerly chemist in the United States Geological Survey, is to take charge of analytical research for the Solway Process Company, Syracuse.

Robert Du Bois and Dr. Veillon, of the Monsanto Chemical Works, St. Louis, have been elected directors of the Graesser-Monsanto Chemical Works, Ltd., of Ruabon, North Wales. N. H. Graesser is the managing director of the new company.

Dr. F. S. Mortimer, formerly secretary of the Iowa Section of the American Chemical Society, is now on the staff of the National Aniline & Chemical Co., Buffalo, N. Y.

Arthur N. Laury, formerly with the General Chemical Co., is now with the Aetna Explosives Co., 165 Broadway, N. Y., attached to the staff of C. A. Bigelow, general manager.

Mr. Leroy M. Law, formerly chief chemist of the Inter-ocean Oil Co., New York and Baltimore, is now with the New Orleans Refining Co., 233 Broadway, New York.

Edwards F. Wilson, formerly in charge of the Ironmasters' Laboratory and later chief chemist of Virginia Iron, Coal & Coke Co. and of Westmoreland Coal Co., has opened a commercial testing laboratory and consulting office at 222 S. 3d street, Philadelphia, Pa., where he will re-engage in private practice, specializing in fuels, iron and steel, industrial waters, etc.

Marion Speiden, formerly of the National Aniline & Chemical Co., 21 Burling Slip, N. Y., is now manager of the chemical department of Rockwell & Victor, 22 Cliff St., N. Y.

George P. Mills, formerly electrical sales engineer of the General Electric Company, Philadelphia, has joined the staff of the Electric Furnace Construction Co., Philadelphia, to take charge of and specially develop electrical industrial heating furnaces.

Eller K. Files, formerly City Chemist in Cincinnati, Ohio, has become assistant manager of the pyroxylin department of the Duratex Co., Newark, N. J.

C. L. Wiswall, for several years connected with the Hercules Powder Co., is now production engineer with the Vulcan Detinning Co., Sewaren, New Jersey.

Manufacturing Chemists' Association Hold Annual Meeting

The Manufacturing Chemists' Association of the United States, organized in 1872, held its annual meeting on June 9 at India House, New York City. The chief business taken up at the meeting, which was an executive session, comprised the annual report of the executive committee, which meets monthly in New York and handles most of the business of the association.

The report stressed particularly the success of the committee in co-operating with the Chemical Foundation, Inc., one of the achievements, credit for which is partly taken by the association, being the provision in the constitution and by-laws of the Foundation whereby an advisory committee representing all branches of the chemical industries confers regularly with its officers.

The report devoted a good deal of attention to the progress of dye legislation, representatives of the association having testified at the hearings before Congress and a brief having been filed setting forth its views. The bill imposing a duty of practically 100 per cent. on imports of pyrites, which was killed, was also referred to, together with the association's opposition to this measure.

The work of the National Industrial Conference Board, especially relating to the campaign for revision of the tax laws, was commended by the executive committee, and the importance of the Washington office of the association, which not only keeps members informed of legislative proposals, but aids them in the case of coal or car shortages or other matters where official assistance hastens action, was brought out at some length.

Dr. Charles L. Reese, of E. I. du Pont de Nemours Co., was elected president of the association, succeeding T. S. Grasselli, of Cleveland. Other officers chosen were H. H. S. Handy, of the Semet-Solvay Company, vice president; C. Wilbur Miller, of the Davison Chemical Company, vice-president; Lindsley Loring, vice president of the Merrimac Chemical Company, treasurer, and Arthur H. Weed, 84 State street, Boston, secretary. The executive committee was elected as follows: Henry Howard, Grasselli Chemical Company; Lancaster Morgan, General Chemical Company; H. H. Dow, Dow Chemical Company; Adolph Rosengarten, Powers-Wightman-Rosengarten Company; Mr. Miller and D. W. Jayne, the Barrett Company.

That confidence on the part of the chemical industries in the ultimate adoption of a measure by Congress furnishing adequate protection to the dyestuff makers has not disappeared, notwithstanding the adjournment without favorable action on the Longworth bill by the Senate, was attested by the sentiment of the members present.

The delay which has been encountered is admitted to be discouraging, but assurances have been received which make it clear that a majority of the Senate will support a measure giving the industry the protection it desires. Whether the licensing feature will finally be approved is an open question, but something more is expected than high duties strengthened possibly by anti-dumping provisions, such as those proposed, which it is felt would be ineffective.

The following concerns are members of the Association:

Armour Fertilizer Works, Chicago; Barrett Co., New York; Baugh & Sons, Philadelphia; Henry Bower Chemical Mfg. Co., Philadelphia; Calco Chemical Co., Bound Brook, N. J.; B. P. Clapp Ammonia Co., New York; Columbia Chemical Co., Pittsburgh; Consolidated Color & Chemical Co., New York; Contact Process Co., Buffalo; Davison Chemical Co., Baltimore; Detroit Chemical Co., Detroit; Dow Chemical Co., Midland, Mich.; E. I. duPont de Nemours & Co., Wilmington; General Chemical Co., New York; Grasselli Chemical Co., Cleveland; Harshaw, Fuller & Goodwin Co., Cleveland; Herf & Frerichs Chemical Co., St. Louis; Heller & Merz Co., Newark; Heyden Chemical Works, New York; Hooker Electrochemical Co., New York; Hord Color Products Co., Sandusky, Ohio; Kalbfleisch Corporation, New York; E. C. Klipstein Sons Co., New York; Chas. Lenning & Co. (Inc.), Philadelphia; Mallinckrodt Chemical Works, St. Louis; Mathieson Alkali Works, New York; McKesson & Robbins (Inc.), New York; Merck & Co., New York; Merrimac Chemical Co., Boston; Michigan Alkali Co., Detroit; Mutual Chemical Co., New York; National Ammonia Co., Philadelphia; National Aniline & Chemical Co., New York; National Lead Co., New York; Naugatuck Chemical Co., Naugatuck, Conn.; New England Fuel & Transportation Co., Boston; Newport Chemical Works, New York; Nichols Copper Co., New York; Pennsylvania Salt Mfg. Co., Philadelphia; Chas. Pfizer & Co. (Ltd.), New York; Philadelphia Quartz Co., Phila.; Powers-Weightman-Rosengarten Co., Phila.; Roessler & Hasslacher Chemical Co., New York; Rollin Chemical Co. (Inc.), Charleston, W. Va.; Semet-Solvay Co., Solvay, N. Y.; Solvay Process Co., Syracuse, N. Y.; Tartar Chemical Co., New York; U. S. Industrial Alcohol Co., New York; Western Chemical Mfg. Co., Denver, Colo.

More By-Product Ovens

In connection with statements that the tar supply from by-product coke ovens is barely meeting the needs of consumers comes the announcement that 853 such ovens are now under construction, scheduled for completion before the close of the current year. In 1919, 758 new ovens were completed and 510 added to existing plants.

Owing to the great demand for coal by-products and the more profitable production of coke in this manner, there is a rapid growth in the extension of the by-product coking industry. The iron and steel industry is responsible for virtually all the developments of this character.

Coke oven production of tar in 1918 was approximately 263,000,000 gallons, or about two-thirds of the total output. The new by-product plants lately completed or building will much increase this output.

Companies now building coke ovens are: Birmingham Coke & By-Products Co., 50; Sloss-Sheffield, 120; Tennessee Coal, Iron & R. R., 77; St. Louis Coke & Chemical Co., 80; Donner-Union Coke Corp., 150; Lackawanna Steel, 60; Cambria Steel, 60; Jones & Laughlin Steel, 60; Pittsburgh Crucible Steel, 100; Domestic Coke Corp., 60, and Steel & Tube Co. of America, 36.

Personal Items

Arthur L. Davis, formerly assistant catalytical chemist at the Fixed Nitrogen Research Laboratory, American University, Washington, D. C., is now research chemist with the International Coal Products Corporation, Newark, New Jersey.

* * *

The Joseph Dixon Crucible Co., Jersey City, N. J., submits its senior vice-president, George E. Long, for second honors for continuity of service, Sereno P. Finn, vice-president and treasurer of the Sherwin-Williams Co., having undisputed first place in his 50 years of service to his company. Mr. Long began as a stenographer and in his 43 years' association with the Joseph Dixon Crucible Co has not only filled successfully the offices of secretary, treasurer and vice-president, but has been an active agent in the development of the graphite industry.

* * *

James C. Gray, senior member of the law firm of Gray, Thompson & Rose, Pittsburgh, Pa., has been elected president of the Standard Chemical Co. Mr. Gray was active in the organization of the American Vanadium Co., now the Vanadium Co. of America, and long has been in charge of the Flannery business interests.

* * *

The city of Boston has engaged Arthur D. Little, Inc., of Cambridge, Mass., to investigate the gas manufacturing practice of the Boston Consolidated Gas Co. to ascertain if conditions justify an increase in rates to consumers.

* * *

C. A. Olcott and E. F. Babbitt, of the S. S. Heworth Co., centrifugal machine manufacturers, 2 Recor street, N. Y., have been appointed, respectively, general manager and assistant manager of that company.

* * *

The D. Van Nostrand Co., with 72 years of service in the publication and selling of technical books, announces its removal to its own building at 8 Warren street, N. Y., with increased facilities of service to American industry whose development has been practically contemporaneous with the history of this well-known house.

* * *

Dr. Percy W. Punnett, formerly in the organic research laboratory of the Butterworth-Judson Corporation, Newark, N. J., is now chemist for the Rochester Button Co., Rochester, New York.

* * *

Philip Weisenthal, formerly connected with the Chemcraft Company of this city, is now associated with Weisenthal & Co., located at 145 West Forty-fifth street, New York, which organization handles heavy and fine chemicals.

* * *

Oregon B. Helfrich has just received his Ph.D. degree from the Johns Hopkins University and has accepted a position with E. I. du Pont de Nemours & Co., doing research work in the Delta Laboratory of that company at Arlington, New Jersey.

* * *

F. P. Robert, J. J. Gardiner, F. E. Barnham and K. Nakagami, all formerly connected with the foreign department of Ralph L. Fuller & Co., Inc., have or-

ganized the F. P. Robert & Co., Inc., capitalization \$100,000, to trade in chemicals. F. P. Robert is president.

* * *

Ernest Marcelis, formerly with the Semit-Solvay and Solvay Process Companies of Syracuse, N. Y., and more recently with Chas. T. Stork & Co., Inc., and Philip L. Davis, Inc., of New York, and Arstur Busch, formerly with the National City Bank and later with Chas. T. Stork & Co., Inc., have organized Marcelis & Busch, Inc., to conduct a general chemical and drug brokerage business at 15 Park Row, New York City.

* * *

The firm of Stone & Webster has been incorporated under Massachusetts laws and henceforth will be known as Stone & Webster, Inc. The partnership has consisted of Charles A. Stone, Edwin S. Webster, Russell Robb, Henry G. Bradley, Frederick P. Royce, George O. Muhlfeld, Henry B. Sawyer, Frederick S. Pratt, Harry H. Hunt and Howard L. Rogers. Stone & Webster, Inc., will continue the business with the same personnel.

* * *

H. A. Bumstead, professor of physics at Yale, has been elected chairman of the National Research Council for the year beginning July 1. C. D. Walcott, president of the National Academy of Sciences, was elected first vice-chairman, and Vernon Kellogg, professor of biology, Stanford University, secretary.

* * *

Dr. Victor C. Alderson, president of the Colorado School of Mines, is on his way to England where he will investigate oil shale conditions.

* * *

Henry Howard, chairman of the executive committee, of the Manufacturing Chemists' Association, and formerly vice-president of the Merrimac Chemical Co., is now a member of the executive staff of the Grasselli Chemical Co., with headquarters at Cleveland, Ohio.

* * *

C. P. Wilson, formerly chemist for the Exchange Lemon By-Products Co., is in charge of the research laboratory at Corona, Cal., just established by the California Fruit Growers' Exchange. The laboratory will be devoted to the development of commercial processes for the utilization of the by-products of exchange member plants.

* * *

Col. M. E. Brewster-Greene, after two years' staff duty in France and Italy, is now an executive of the John Johnson Co., filter press manufacturers, at its Brooklyn, N. Y., plant. Col. Brewster-Greene formerly was assistant advertising manager of the Locomobile Co. of America.

* * *

Frank H. Lowenfels is head of the new filtration department recently established by Holz & Co., metallurgical engineers and dealers in testing equipment, 17 Madison avenue, New York. The new department is prepared to supply specifications for all types of laboratory and plant filtration equipment. Herman Holtz, of Holz & Co., is at present in Europe arranging for the importation of the latest improved metal testing equipment.

Industrial Notes

The Edward Hines Lumber Co., Chicago, Ill., will erect at their mill at Lumberton, Miss., a plant to make chemicals derivable from wood.

* * *

The Aluminum Co. of America, Pittsburgh, Pa., will build on the Tennessee river, near Maryville, Tenn., a 75,000 H. P. hydroelectric plant. This development is a continuation of plans for several hydroelectric stations.

* * *

The United Sugar Corporation, H. A. Johns, 1512 Walnut street, Philadelphia, Pa., will build at Palatka, Fla., a \$2,000,000 sugar refinery. Its plans to establish the sugar industry in that state embrace contracts for cane cultivation, 12,000 acres already having been pledged and a portion planted, and the erection of several crude mills to supply the refinery.

* * *

H. J. Heinz Co., Pittsburgh, Pa., will build a vinegar factory at Asheville, N. C.

* * *

The loss by fire of the naphthalene plant of the Barrett Manufacturing Co., at Philadelphia, on May 18, has affected strongly the market for this product. The annual output was at the rate of 30,000,000 pounds. Four carloads, 180,000 pounds, of naphthalene was destroyed, and several months will be required before production again is under way.

* * *

Standard Chemical Co. will remodel building and build additional plant costing \$12,000 at Huntington, W. Va.

* * *

Leggett & Meyers Tobacco Co., 1441 Park avenue, St. Louis, Mo., will build 2-story, 56x100, plant for chemical manufacture.

* * *

Mutual Chemical Co. of America, 55 John street, N. Y. C., will enlarge its Baltimore plant.

* * *

Ocean Leather Co., 120 Liberty street, N. Y. C., manufacturers of leather from shark and porpoise, will build fertilizer plant and tannery at Fort Meyers, Fla.

* * *

The American-La France Fire Engine Co., Inc., manufacturers of safety equipment, Elmira, N. Y., have enlarged their administration building by an additional story for the accommodation of their engineering, purchasing and sales departments.

* * *

The General Chemical Co. has requested the Providence, R. I., Town Council to modify the municipal ordinance relating to the manufacture and storage of acids preliminary to plans to erect at Rumford a plant involving an investment of \$2,000,000, if decision to locate there is made.

* * *

The Bain Peanut Co., F. B. Bain, president, of Norfolk, Va., will erect at Albany, Ga., a complete up to date plant for the handling of peanuts. The buildings and equipment will be adapted to receive 3-6 cars per day of shelling peanuts, and include peanut-hull grinding, screening and bagging machinery and conveying apparatus.

The Pacific Coast plant of the General Chemical Co. will be located at El Segundo, Cal., and will cost with equipment over \$1,000,000. The J. G. White Engineering Co., 43 Exchange place, New York, is in charge of construction.

* * *

The Davis-Bournonville, Co., Jersey City, N. J., manufacturers of oxy-acetylene and oxy-hydrogen welding and cutting apparatus, has acquired a new and larger factory location for its Canadian plant at Toronto to which place the Niagara Falls plant will be moved.

* * *

American Agricultural Chemical Co. will rebuild its plant at Henderson, N. C., recently destroyed by fire at a loss of half a million dollars.

* * *

Hires Root Beer interests have acquired control of the Cardenas-American Sugar Co. and have changed its name to Hires Sugar Co. The company has a sugar estate of about 50,000 bags annual production in the Province of Matanzas, Cuba. Acquisition was for the purpose of assuring a supply of sugar for the manufacture of root beer.

* * *

Ebolite Company, of Albany, casein, formaldehyde, etc., has been incorporated by W. T. Mayer, J. B. Hydorn, and R. M. Ritter, 53 West 88th street, New York.

* * *

Cincinnati Chemical Works has been incorporated in Delaware with a capital of \$2,500,000 by Albert R. Palmer, Madison, N. J.; Frank R. Harles, East Orange, N. J., and George F. Handel, New York.

* * *

The Staier Chemical Co., 81 Fulton street, New York, dyestuffs manufacturers, is engaged actively in rebuilding the damaged portions of its Newark plant, which was wrecked by a recent explosion, causing a loss of \$50,000.

* * *

The Gulf Coast Oil Jobbing Co., Galveston, Texas, L. E. Landon, president, will build a \$100,000 plant on a 500x1,750 plot on the Galveston ship channel for the manufacture of lubricating greases from petroleum.

* * *

The Procter & Gamble Co., Cincinnati, Ohio, have secured an option on a 30-acre tract on San Francisco Bay, near Richmond, Cal., in pursuance of plans to establish a soap plant at that place.

* * *

Katzenbach & Bullock Co., Inc., formerly at 100 William street, are now installed in its recently purchased 6-story and basement building at 440 Washington street, New York.

* * *

The Elyria Enameled Products Co., Elyria, Ohio, have now enlarged, new headquarters for its New York office at 103 Park avenue.

* * *

The reconstruction of the plant of Toch Bros., paint makers, at Long Island City, N. Y., following upon the complete loss of the color and chemical departments by fire in February last, is proceeding rapidly. The 2-story, 50x100 brick and concrete building now under construction is the first unit of a series scheduled for construction.

Merck & Co. will build at their plant at Rahway, N. J., a 4-story 50x100 laboratory costing \$175,000.

* * *

U. S. Dye & Chemical Co., E. Brownstein, president, will construct at Gary, Ind., a \$200,000 plant.

* * *

The Jordan Coal Tar Products Co., 11 Cliff St., New York, James A. Dowd, vice-president and general manager, expects to have in operation by July 1, its new plant at Matawan, N. J., for the production of coal tar products.

* * *

Canadian capitalists organized as Chemical Products, Ltd., capitalization \$2,000,000, have secured the huge plant of the British Chemicals, Ltd., formerly operated by the Imperial Munitions Board at Trenton, Ontario. More than eighty buildings of various character compose the plant, located on a 255-acre tract, in which will be manufactured an extensive line of chemicals imported from Germany before the war. It is believed that this one plant will supply all the needs of Canada.

* * *

The Citrus Soap Co., San Diego, Cal., will build a 4-story 200x300 feet soap factory in that city, costing \$200,000.

* * *

The Whitall-Tatum Co. will build a 3-story 50x200 foot plant for the manufacture of glassware at Keyport, N. J., costing \$100,000. H. H. Vought, Grand Central Terminal, New York City, has the contract.

* * *

Hemingway & Co. are enlarging their plant at Bound Brook, N. J., by the erection of three buildings of 3 and 4 stories costing \$125,000.

* * *

The Brown Co., Berlin, N. H., have acquired from the St. Lawrence Industrial Lumber Co., Sherbrooke, over 400 sq. mi. of timber limits, together with 126,000 acres of free hold land. The whole area is located at Bersimis, Quebec, on the north shore of the St. Lawrence River.

* * *

The Atmospheric Nitrogen Company, formed late last year by the Solvay Process Company and the General Chemical Company, with authorized stock of \$5,000,000, has begun erection of the first unit of a plant for fixation of atmosphere nitrogen. The buildings and equipment of the first unit will be completed in about a year and will cost more than \$2,000,000.

A large tract has been acquired near the Solvay Process plant, and if present plans are carried out an extensive new chemical industry will be built up. E. L. Pierce, president of the Solvay Process Company and vice-president of the Somet-Solvay Company, is president of the Atmospheric Nitrogen Company.

* * *

An extensive plant for manufacturing photographic chemicals will be established at Kingsport, Tenn., by the Eastman Kodak Company, of Rochester, N. Y., which has been investigating the subject for several months with the result that Government war buildings erected at Kingsport at a cost of more than \$1,000,000 have been purchased by the Eastman Kodak Company as a nucleus for its branch factory. It is understood that the initial investment will require about \$250,000 for machinery in addition to the purchase price of the property.



Co-operative Chemical Research

The war gave applied chemical research the greatest impetus that science has ever known. In keeping with its progressive program, The New Jersey Zinc Company has recently built the most extensive, most completely manned and best equipped research laboratory in the field of zinc.

Through this institution we cooperate with clients in the chemical and mining field in both research and test work, to develop the highest quality of zinc products and determine their most economic application in various industries. Bring your technical problems to us.

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Observations in Dyestuffs Manufacture Abroad

By Herman A. Metz

CONDITIONS in Europe, so far as dyestuffs are concerned, are rather mixed. Very little progress has been made apparently by the French, and the English are to a large extent still buying intermediates and some colors in the United States, although they are undoubtedly making progress in certain lines in which we have not yet done very much.

The Germans are by no means doing what one would suppose from the reports received here from so-called experts who went over to investigate conditions. It is true I can confirm that in most of the plants, and I visited five of the so-called "Bix Six" and saw the sixth from the outside, "smoke was coming out of most of the chimneys" but I learned that instead of burning decent coal, peat briquettes, brown coal, wood and in some cases rubbish were being burnt. The practical man knows that things of this kind produce much smoke but comparatively little steam, and, therefore, not much power, so you cannot always tell what a concern is doing by the amount of smoke coming from the chimney. As a matter of fact, so far as dyestuffs are concerned, it is safe to say that not one of the concerns is running up to a third of its capacity, and most of them less. The list recently published by the Textile Alliance of stocks on hand of various colors and available for export shows how the reports of stocks on hand and ready to be dumped on America were exaggerated.

Most of the plants have been greatly extended,



HERMAN A. METZ.

so far as plant is concerned, since the war, but the increases are due to the manufacture of products other than colors, chief among them being the nitrates now available for fertilizer, synthetic acetic acid, as well as substitutes for rubber, gums, shellac, etc., which have become large items of production. The color plants, as a matter of fact, have been to a large extent demolished, the apparatus being used for other purposes, and practically the entire color department has to be reorganized and rebuilt before anything like normal production can be reached. That this will take a long time may be assumed from the fact that all copper vessels have to be entirely replaced as copper was largely commandeered, and there is at the present time a great shortage of raw materials of every kind in Germany so that machinery and parts of machinery cannot be obtained.

I tried to order a microscope and polariscope from one of the largest manufacturers in Germany. The best price that was obtained for me was an increase of 800 per cent. over the catalog price, that price not guaranteed, and no delivery promised before at least eight months, the delay being caused by the fact that necessary parts could not be obtained. I mention this only as an illustration, for what holds good for scientific instruments holds good for machinery of all kinds.

The German manufacturers realize fully that the American market as such is lost. They know that we can produce the bulk or quantity goods, such as the azo colors, direct colors, sulphur colors,

etc., practically as cheaply as they can because labor is rather a small item and we have the raw material available at even better prices than they have. What they are worried about is their business in China, South America, India and other countries that are large consumers.

If they can hold the trade of those countries, they will be quite willing to forego ours and not worry us with competition on this side. They will be quite satisfied in the meantime to get orders for such of the products as we are not making here, which include the vat colors and some of the more complicated dyes from toluol, anthracene, etc.

Under the treaty the Allies have a right to demand 25 per cent. of all colors and certain intermediates which they produce, and this 25 per cent. will be divided between England, France, Belgium, Italy and ourselves.

Assuming that the countries mentioned, which include the British possessions such as India and Canada, formerly consumed a half of all the colors produced, this 25 per cent. of such of the colors as we would request under the treaty because we are not making them would cover about one-half of our normal consumption before the war, assuming that our consumption had not increased. This would necessitate the Allies obtaining by purchase another 25 per cent. besides what they get under the treaty. If our textile plants want to hold their own, it will be necessary to get our share of this other half before the rest of the Allies get hold of it.

Undoubtedly we will eventually be able to produce these colors on this side; also at a price that will enable our mills to obtain them on an equal basis with British, French and other textile manufacturers. These colors, for specific purposes, will come in if they cannot be obtained here, for either they will come as dyes or they will come as finished goods on the fibre and our textile people will lose just that much of their mill production.

The German textile mills will be unable to compete for some time to come owing to the lack of cotton and wool, and the fact that the rate of exchange is so much against them; but their plants are intact, their labor is there, and all they have to sell at the present time, or for some time to come, is their labor. Arrangements are being made by other countries for using the plants and the labor in various industries.

It appears to me that a great opportunity offers itself to American manufacturers to obtain and retain a large part of the export market, particularly on cotton goods. There is no reason why our manufacturers could not send cotton to Germany, have it spun, dyed and woven into such fabrics as South and Central American countries most desire, export the finished product directly from Germany to those countries for account of the American mills, and thus get a line on those markets and the benefit of the lower cost of production which the exchange rate now gives us, as against English, French and German manufacturers in those markets.

We could then, when conditions warrant it, put our looms on to those goods instead of having the lion's share of cotton goods consumed by the world at large manufactured with

our cotton on British, French and German looms, as in the past. The German mills do not like the proposition but it is the only way they can keep their help occupied, and unless the working classes of Germany are employed and able to support themselves, the conditions will be like those of Russia before very long.

I for one, with very heavy investments in American plants manufacturing dyestuffs, and knowing conditions as I do, have no fear of being driven out by German competition for some years to come, and the longer I am allowed to go on, the safer I consider myself against such competition.

In addition to other handicaps, the German Government is fixing the "export price" on all goods sent out of Germany and is imposing a 10 per cent. export tax on that price. As the one essential thing the German Government has got to do is to raise money, it is not likely that this additional tax will be reduced for some time to come.

New Chemical Import Regulations

The War Trade Board Section of the State Department has issued new regulations for the importation of commodities whereby the rulings of August 15, 1919, of the War Trade Board have been revised and extended to permit importation into the United States from all countries of all commodities without individual licenses, except synthetic organic drugs, synthetic organic chemicals, dyestuffs, products derived directly or indirectly from coal tar, including crude and intermediate products and mixtures and compounds of such products. For the importation of all these excepted commodities individual import licenses will continue to be required. This will control the importation of dyestuffs from Germany.

Synthetic Organic Drugs and Chemicals

Licenses for the importation of dyestuffs of German make or origin, similar kinds or satisfactory substitutes of which are unobtainable in the United States on reasonable terms as to price, quality and delivery, may be granted for limited quantities for use of consumers to meet their own special manufacturing requirements, in conformity with special rules and requirements.

Licenses are not being granted for the importation into the United States or its possessions of synthetic organic drugs or synthetic organic chemicals of German make or origin if the same drugs or chemicals, or satisfactory substitutes are obtainable in sufficient quantities from domestic sources on reasonable terms as to price, quality and delivery, to supply domestic requirements.

Native Drugs and Chemicals

Native drugs and chemicals in their earthly state as mined or grown which have been subjected to no chemical treatment whatever, may now be imported into the United States from any country in the world without a license, the same as before the war, and no formalities are now necessary with the War Trade Board Section in connection with the importation of such commodities.

Dr. H. S. Riederer, who was formerly engaged in commercial chemical development at the Experimental Laboratories of the Atlas Powder Co., is now with the United Color & Pigment Co., Newark, N. J.

The American Institute of Chemical Engineers

The Twelfth Semi-Annual Meeting in Canada the Best Attended and Most Successful in Its History

THE Canada meeting of the American Institute of Chemical Engineers always will be remembered as one at which opportunity was accorded the members of this American society to meet some of the most prominent Canadian chemists, business men and political leaders and to become acquainted with the typography and natural resources as well as the industrial development of the great Dominion.

The Canadian Government contributed much to the convenience and entertainment of the members and guests by providing a special train to take the visiting Americans to the cities selected for the itinerary. Mr. C. Price-Green, Industrial Commissioner of the Canadian National Railways, accompanied the party on the entire trip. Mr. Price-Green arranged the train schedule to suit the convenience of the party at every point visited, moving the party locally or from town to town as needed. W. R. Kelley, General Superintendent, C. N. R., attached his special car and accompanied the party the first day. Major G. G. Ommanney, of the Department of Development, and Mr. Norman L. Rankin, Special Publicity Agent, C. N. R., took the entire trip on the train.

In Montreal June, 28-30

The meeting opened in Montreal on Monday morning, June 28th, at the Hotel Windsor. The address of welcome was delivered by City Commissioner R. A. Ross, President of the Engineering Institute. David Wesson, Manager of the Technical Department of the Southern Cotton Oil Company and President of the Institute, responded.

At the business session in Montreal the reports of the Council and officers showed a great deal of active work by the Institute and an unusual growth during the past six months, the membership being at present over 400. New Orleans was selected as the place for the winter meeting and Detroit for the summer meeting. The invitation from Detroit was presented by Mr. C. T. Bragg of the Michigan Smelting and Refining Company.

The program of papers which followed was of a very high order of excellence, covering several important fields of chemical engineering.

The symposium on Electrolytic Cells was introduced by Mr. C. B. Barton, of the Brown Company, who described the development of the first commercial electrolytic cells.

Mr. Hugh K. Moore, Chief Chemist and Chemical Engineer of the Brown Company, discussed the fundamentals of the electrolytic diaphragm cells and the development and performance of the Allen-Moore cell. Mr. L. D. Vorce of the Canadian Salt Company described the Vorce vertical cylindrical cell and Mr. A. H. Hooker, of the Hooker Electro Chemical Company, described, with lantern slides, the installation of Townsend cells at the Niagara Falls plant of his company. Mr. Hooker also read a paper giving the results of a very extended study of the solubility of salt in caustic soda solutions at various temperatures.

Mr. Richard K. Meade read a paper illustrated with lantern slides giving a very complete description of the manufacture of lime for chemical and metallurgical purposes.

Prof. W. L. Badger of the University of Michigan gave an illustrated paper on the new evaporatory laboratory at the University of Michigan and also presented three other papers giving the results of studies on evaporation carried out in this laboratory.

Mr. W. D. Richardson, of Swift & Company, read three papers, giving results of a very extended study of the corrosion of a considerable variety of samples of steel. Very marked differences in corrosion were found when sulphuric acid and oxy-acids, such as nitric acid, were allowed to act on the metal.

An excellent review of the progress recently made in the by-product coke oven industry was given by Mr. C. R. Bellamy of the Somet-Solvay Company.

Mr. H. O. Chute gave a comprehensive survey of Dendro-Chemistry and Mr. E. B. Miller gave the results of commercial experiments on adsorption by means of Silica Gel.

On Tuesday afternoon the glycerine refinery of Marx and Rawolle was visited. In this plant the glycerine is refined by the Wood multiple-effect distillation process. Mr. F. J. Wood himself was on hand to explain the process to the visitors. The very extensive plant of the Canada Malt Co., Ltd., was then visited. The very up-to-date mechanical method of handling the barley and malt was much admired.

The entertainment and social features of the meeting in Montreal included a dinner at the Hotel Windsor on Monday evening. About 175 were in attendance. President David Wesson acted as toastmaster and called upon the following for three-minute toasts: R. H. Monk, Prof. J. W. Richards, A. M. Comey, Robt. S. Weston, J. Takamine, H. G. Sidebottom, Wm. D. Richardson, Secretary, J. C. Olsen, Prof. Charles Baskerville, Mrs. A. M. Comey and Mrs. A. H. Hooker.

On Tuesday evening, Prof. R. F. Ruttan of McGill University entertained a number of the officers and members at dinner at the Mount Royal Club. This was followed by a smoker at the Hotel Windsor.

The ladies were given a motor drive in and about Montreal Monday afternoon, and a trip around the harbor on Tuesday afternoon and a theatre party on Tuesday evening.

The local program in Montreal had been arranged by a committee consisting of Mr. R. H. Monk, of McArthur, Irwin, Ltd.; Wm. B. Campbell, Asst. Supt., Forest Products Laboratories, McGill University; and J. S. Keith, Secretary of the Engineering Institute of Canada. The local ladies' committee consisted of Mrs. R. H. Monk, Mrs. J. S. Keith and Mrs. A. G. Beck.

En Tour, June 30-July 5 Ottawa

On Wednesday morning, June 30, the four-day tour of the Canadian industries began, the party leaving Montreal at 8:15 A. M. by the Institute Special. Ottawa was reached on schedule time at 12:00 noon. Here the train was met by the local entertainment committee headed by Edgar Stansfield, Chairman, and S. J. Cook, Secretary, of the Ottawa Section of the Society of Chemical Industry, which had arranged for the entertainment of the chemical engineers while in Canada.

The party was taken immediately to the Chateau Laurier, where luncheon had been provided by the

Society of Chemical Industry. After an address of welcome by the Chairman, Mr. Edgar Stansfield, which was responded to by President David Wesson, the Right Honorable Sir George Foster, Minister of Trade and Commerce and acting Premier, was introduced and gave a most eloquent address. The other speakers were Mayor Harold Fisher for the city; Mr. John Bingham, President of the Board of Trade; Honorable J. G. Foster, United States Consul, and Chas. Camsell, Deputy Minister of Mines.

The party was then taken in two special electric cars to the works of the E. B. Eddy Company, manufacturers of sulphite pulp, paper and indurated fibre products. All parts of the process were inspected, after which an automobile tour, which had been arranged for by the Board of Trade was taken, giving opportunity to see the Parliament and other beautiful buildings of Ottawa. The tour extended through Lady Grey Drive to Rockcliffe, returning past the Exposition Grounds to the city. This gave an excellent opportunity to see to the best advantage the natural beauty of the locality.

Belleville and Delora

At 6 P. M. Wednesday, June 29, the party boarded the special train for the trip to Belleville, through the scenic Rideau Lake district. The train was met at Belleville by the local reception committee, headed by Capt. Lucius E. Allen and Acting Mayor R. D. Ponton and the G. W. V. A. band. After a number of selections had been rendered by the band the party was escorted to the Hotel Quinte, where an address of welcome was given by Captain Allen.

On Thursday morning, June 30, a photo of the entire party was taken, after which automobiles were provided by the citizens of Belleville for a motor drive about the city and a tour to Delora via Sterling and Marmora, viewing en route the beautiful Oak Hills and Trent Valley.

Immediately on arrival at Delora luncheon was served in the Club House by the Delora Smelting & Refining Co., Mr. S. B. Wright, manager of the plant, acting as host and giving a fine address of welcome.

The visit to the plant of the Delora Smelting & Refining Company proved very interesting. The separation of cobalt, nickel, iron and arsenic involved the carrying out on a commercial scale of some complicated chemical reactions. The extensive settling chambers and bag house for the collection of the arsenic fumes was examined with interest as well as the electric furnaces in which the nickel, cobalt and stellite metal were melted.

The next stop was at the talc mines and then at the mills of G. H. Gillespie & Company, where the talc was ground in ball mills and air-floated and passed through screens until reduced to an impalpable powder.

The extensive plant of the Industrial Alcohol Co., Ltd., at Corbyville, was then visited under the guidance of W. J. Hume, Manager, and Geo. Appelle, chief Chemist.

A reception given by Mrs. L. E. Allen at the Belleville Club followed the return to Belleville. During the day the visiting ladies were given automobile rides about the city and along the shores of the Bay of Quinte.

The Belleville Banquet and the Medal to Moore

At 8:00 P. M. Thursday, July 1, the members of the Institute and the most prominent citizens of Belleville took dinner at the Hotel Quinte, the dining-room being filled to capacity. Capt. Lucius E. Allen acted as

toastmaster, introducing equally well his local friends and the members of the Institute. With the Stars and Stripes and the Union Jack draped above the speakers' table many references were made to the cordial relations existing between the Dominion of Canada and the United States.

President David Wesson especially emphasized this point. Secretary J. C. Olsen told the people of Belleville what a chemical engineer is, although he said this is a much-discussed subject.

Dr. S. P. Sadtler, the first president of the Institute, presented the Institute Medal to Mr. Hugh K. Moore for the best series of papers presented to the Institute since 1913, when the medal was awarded to Dr. F. W. Frerichs. Mr. Moore responded in a very happy speech, remarking that his papers were so long that they boosted the price of paper. Prof. Chas. Baskerville responded to the toast, the President of the United States.

Among the prominent Canadians present Lieut. Col. Ponton spoke very effectively on "The City of Belleville and the County of Hastings," pointing out that it was very appropriate that on Dominion Day citizens of the great Republic and the great Dominion should celebrate the day together. Other speakers were Hon. Nelson Parliament, speaker of the Ontario Legislature, and Major Richard D. Ponton, Acting Mayor of Belleville, William H. Nugent and Mr. John Elliott.

The local entertainment committee comprised Major R. D. Ponton, E. P. Fredericks, W. J. Hume, S. W. Wright, Geo. Appell, G. H. Gillespie, Wm. H. Nugent, Harry J. Ackerman, J. A. Higgs, W. H. DeBlois, S. R. Burrows and Chas. Hanna.

The dinner, tendered complementarily by the City of Belleville and the County of Hastings, was a most gracious expression of cordiality.

Shawinigan Falls

At 11:30 P. M. the party proceeded by the Institute Special to Shawinigan Falls, where the visitors were met Friday morning, July 2, by the following entertainment committee and escorted through the various plants at this point: F. W. Skirrow, Shawinigan Laboratories, Ltd.; C. R. Lindsey, Shawinigan Water & Power Co.; Mr. Witherspoon, Works Manager, Canada Carbide Co.; John Stadler, Manager, Belgo-Canadian Pulp & Paper Co.; Mr. Acton, Supt. Northern Aluminum Company; Mr. Reid, Supt. Canadian Electro Products Co.; Mr. Neild, Supt. Canadian Aloxite Co., and Mr. Dessaulles, Shawinigan Water & Power Company.

The extensive power development was first visited. The plant of the Canada Carbide Company was then inspected. The large 40-ton continuous calcium carbide furnace was observed with great interest. The plant of the Canada Electrode Co. was then visited and the process of making the enormous electrodes for the carbide furnaces shown. The manufacture of acetic aldehyde and acetic acid from acetylene was shown at the plant of the Canadian Electro Products Company.

The last plant visited at this point was that of the Belgo-Canadian Pulp & Paper Company. This was found to be an unusually well managed pulp and paper plant.

An informal complimentary dinner was served by the associated industries at Shawinigan Falls at the Cascade Inn. The dinner was greatly enjoyed as well as the social festivities which followed.

La Tuque

The following morning, Saturday, July 3, the party

arrived by the special train at La Tuque, where the enormous sulphate pulp mill of the Brown Company was visited. Here the greatest interest was shown in the Moore process for the evaporation and combustion of the black liquor. The process seemed very simple and was operating satisfactorily.

The Lumberman's dinner, which was served at the Sorting Gap, proved the most novel feature of the entire meeting. The songs of the lumbermen as well as the log rolling, log race, boat race and log chopping contests will never be forgotten by those who enjoyed this novel entertainment.

The entertainment committee at La Tuque consisted of Simons Brown, B. Bjornlund, W. L. Gilman and Fred Gilman.

A Chemist Nominated for the United States Senate

Dr. E. F. Ladd Defeats Senator A. J. Gronna for the Republican Nomination as Senator from North Dakota

AS the result of a three-cornered contest, Dr. E. F. Ladd, a native of New Hampshire and long prominent in the work of the Official Association of Agricultural Chemists, particularly as relates to food control, and in the enforcement of the pure food and drugs act, defeated U. S. Senator Gronna in the recent primary senatorial election in North Dakota.

Dr. Ladd migrated from New England to North Dakota to accept the professorship of chemistry in the State Agricultural College of North Dakota at Fargo. This made him logically a leader in food chemistry, and at the time the Food and Drugs law was enacted he came to the front as State Commissioner in North Dakota. He was generally numbered among the "radical" element in the interpretation of food questions and for a long time battled vigorously with the manufacturers and distributors who opposed the restrictions designed to eliminate adulteration and deceptive branding.

A few years ago the state laws were so changed that Dr. Ladd found himself able to accept the position of president of the State Agricultural College of North Dakota and still direct the food work. This position brought him prominently before the farmers, whose champion he has been consistently in all questions and logically a strong candidate for the Senate when the movement to depose Senator Gronna took form.

Dr. Ladd was the Republican candidate and commanded the support of the Non-Partisan League, winning over Gronna by 3,500 votes.

In reply to our inquiry as to how he got into politics, Dr. Ladd writes as follows:

North Dakota Agricultural College
Office of the President
Agricultural College, North Dakota
July 17, 1920.

Editor, Chemical Age:

You ask how I came to be drawn into politics. That is a hard question to answer.

I have never been in politics, but several years ago, I aided in securing the enactment of several laws, including the Pure Food Law, Pure Drug Law, Sanitary and Purity Law, and since then many others have been enacted, and in addition the Legislature has made it the duty of myself, as Pure Food Commissioner and State Chemist in connection with my work at the Agricultural College, to have these laws enforced. Recently there has been the Grain Grading and Grain Inspection Laws which are also assigned to the Food Commissioner.

On the Saguenay and St. Lawrence to Quebec

Further opportunity to see the numerous lakes and timber lands of Canada was given on the trip by the special train to St. Alphonse on Ha Ha Bay, where the party boarded on Sunday morning, July 4, the S.S. Saguenay for the sail down this broad deep river flowing between immense masses of rock which form its shores. The sail on the St. Lawrence to Quebec proved equally interesting. One hundred of the party stopped at the Chateau Frontenac and visited the beautiful and historic city of Quebec on Monday, July 5, and then scattered for the trip home. The meeting was conceded by all to have been the most profitable, entertaining, and best attended meeting ever held by the American Institute of Chemical Engineers.

Later when I became president of the college, I felt called upon to champion the cause of the farmers and to try to correct certain abuses that then existed in the handling of agricultural products.

Twice I was elected as a member of the Board of Education in the City of Fargo, but in neither election was I a candidate. I served six years on the school board in the City of Fargo, four years as president of the board.

I did not know that my name was being used in connection with the non-partisan meeting for the selection of candidates for office under the Republican ticket. My first information was on the following morning when I read in the papers that I had been placed in nomination for the position of United States Senator. A little later in the day, a committee called upon me and urged that I accept the nomination and allow my name to be used on the ballot and this I did, recognizing fully the honor that the people of North Dakota were willing to pay me in selecting me as their representative in the Senate.

Of course, in the enforcement of the various regulatory laws and in the aiding and selecting of new legislation, I was drawn into intimate contact at various times with the leading statesmen and politicians and members of the Legislature, as well as state administrators. From time to time I was called into conference with regard to industrial and other programs.

Personally, I was not an applicant for any position and have not sought any political position as yet, and yet I feel, of course, with a great deal of pride the fact that I should be drawn to the position for which I have been selected.

Your truly,

E. F. LADD, President.

The Rev. Louis A. Saeger, of Buffalo, N. Y., as a product of his leisure time devoted to the study of chemistry in his ministry of 30 years, has evolved a successful commercial process for the de-inking of paper. The Economy Pulp Co., Buffalo, N. Y., has been organized with a capitalization of \$750,000 to operate the process. The officers are practical paper men of Buffalo and comprise H. J. Simon, president; J. F. Disher, vice-president; G. P. Christgan, treasurer; M. I. Foley, plant superintendent; J. C. Stockman, secretary, and G. A. Peterson, sales manager. A plant has been purchased in Tonawanda with a present capacity of 10-20 tons per day.

Boiler Feed Water

A Chemical Engineer's Problem

By William M. Barr

Consulting Chemist, Union Pacific System

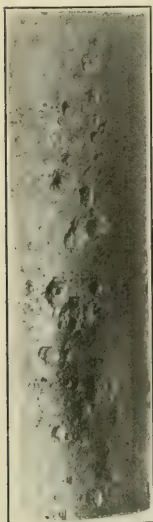


Fig. 1.—Pitting of Boiler Flues.

IN a large number of industrial plants the boiler feed water problem has been allowed to pass with little or no attention for many years. Recent developments indicate that more attention is constantly being given to this important subject which lies at the heart of many large industries.

In the past employers and managers have been inclined to leave the boiler feed water problem, along with all other power plant questions, to the power plant engineer. Combustion problems have been carefully studied in order to increase power plant efficiency, but many times careful study of fuel economy has ignored the question of water supply. Without good feed water the fuel problem is but half solved.

Boiler compounds of varying compositions and usefulness have been on the market for many years, but have too often been sold not because of any merit they may possess, but because of personal relations between the salesman and the power plant engineer. This has resulted in some benefit being derived in certain cases, but in general the results have been entirely out of proportion to the real needs of the plant. It is quite possible to obtain benefit from boiler compounds, but they should be purchased because of their merit and handled under the direction of a chemist who will study conditions. If used, managers should take more interest in the purchase and use of such compounds.

Water treating plants have been built in this country for more than twenty years, but too many installations of this kind have been made without sufficient study of internal conditions of the power plants. There are many idle water softeners that have been allowed to go into disuse because of a lack of the information necessary for successful operation.

The problem of boiler feed water has in too many cases been considered as one of scale removal only and has been attacked from this standpoint alone. The removal of scale-forming salts is comparatively simple and can be accomplished by any water softener having sufficient capacity and careful control.

As the size of power plant units has been increased and steaming efficiency developed to a high degree, the boiler feed water problem has become correspondingly complicated. Higher pressures, reduced water volume and increased circulation have brought about internal boiler conditions which demand careful study by the chemical engineer. It is important that scale-forming salts should be kept out of boilers as far as possible, as a comparatively small thickness of hard scale increases the amount of fuel consumed.

In the modern water tube boiler there are other reasons even more important than this for preventing the formation of scale. A small patch of scale having a thickness of only 1/16 of an inch has resulted in a blow out of a tube due to overheating, resulting in

a boiler failure and the loss of the use of the boiler unit for some time.

Many waters, however, are unfit for use in boilers even though it may be possible to reduce the scale-forming salts to fifty parts per million or less. A water which on analysis shows magnesium in the presence of chloride or nitrate ions is sure to be corrosive. It makes little difference whether the hypothetical combination, made up for interpretive purposes, shows the presence of magnesium chloride and magnesium nitrate or magnesium sulphate and sodium chloride or sodium nitrate. It has been clearly demonstrated that either combination will corrode the boiler.

It has been claimed that corrosion may be avoided by carrying an excess of sodium carbonate in the boilers. However, it has been shown recently that even sodium carbonate in a high pressure boiler is decomposed, resulting in a series of complicated reactions and showing corrosion of the tubes. This may be prevented if the excess of sodium carbonate can be avoided and a slight excess of caustic soda carried instead. The condensate should be carefully studied, as in certain cases it may show the presence of weak acids.

The problem of dissolved gases is one that should not be ignored. The writer has observed cases of serious pitting of flues where cold mountain waters were used under conditions such that no condensate was returned to the boilers. These waters had a total solid content of approximately sixty-five parts per million and from the mineral analysis would be passed as excellent boiler waters, showing low chlorides, low nitrates, only a trace of magnesium and carrying approximately fifty parts per million of incrusting solids, one-half of which was silica. Figures 1 and 2 show the effect of this water on flues after nine months' operation. It is true that this is an unusual condition, but it is such cases that the chemical engineer must meet.

With the modern water tube boiler it is important that foaming properties of feed water be carefully considered. Oil should be kept out of boilers by use of efficient separators, as it is quite common to see oil floating on the condensate after it comes from turbines or engines. This oil when mixed with water carrying excess alkalinity increases the possibilities of foaming. Oil in the condensate has also been responsible for many bagged flues and boilers. It is generally assumed that perfectly clear water should be sent to the boilers. If make-up water is turbid it should be filtered, as suspended matter also increases foaming when combined with a high concentration of dissolved salts.

If compelled to use a water which shows a large excess of sodium salts this concentration must be relieved by frequent blowing off. In spite of the loss of fuel it is necessary to change the water in such

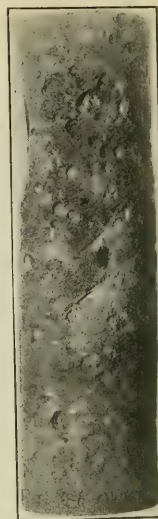


Fig. 2.—Pitting of Boiler Flues.

boilers frequently to avoid foaming. When water of high concentration is permitted to foam turbines may be seriously damaged and at best their operation is greatly impeded.

These are some of the problems which arise in the treatment of boiler feed waters. It is evident from these illustrations that the removal of scale from the feed water is only the beginning of the problem, and that the internal condition and performance of the boiler deserves careful and continuous study. The work of the chemist is greatly increased where no water is available except one that would ordinarily be considered unfit for boiler use. Figure 3 shows an example of a hard sulphate scale which was deposited upon a fire tube boiler flue and no other water was available. This scale was deposited when the water was used without treatment of any kind. It is needless to say fuel losses were great and the life of flues brief. This was a temporary installation and did not justify the expenditure necessary for a water treating plant. It was handled satisfactorily by a compound made for this water.

Figure 4 shows a scale deposited in a condenser by a water used without treatment. This water was replaced by a new supply requiring no treatment. The new water came from wells and was brought in by a pipe line one and a half miles long.

The treatment of water for locomotives is greatly complicated by the conditions under which these boilers operate. They carry 200 pounds pressure, receive no return water, take water from several sources, operate under variable load with greatly changing climatic conditions, while the whole power plant may be moving at a speed as high as sixty-five miles per hour.

The water supplies of different districts may be of entirely different character while engines may be transferred to one district from another, further complicating the problem. It is evident that an industry with from one to two thousand of these moving power plants in addition to many stationary power plants should give serious attention to the boiler feed water problem. Such a problem is large enough to demand constant attention of a chemical engineer and will show ample returns as a result of the study. On the other hand stationary power plants of individual industries should have the same careful attention as the results will be in direct proportion to the work put upon the problem. The increase in efficiency and saving in equipment will amply justify the cost of doing the work thoroughly.

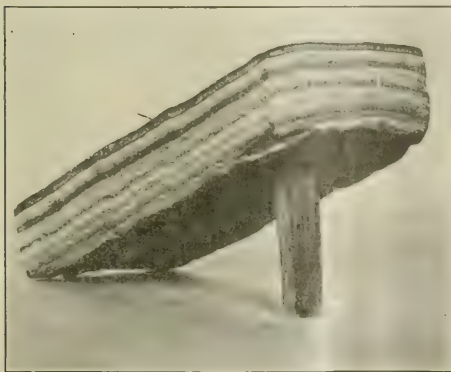


Fig. 3. Scale Deposited on a Fire Tube Boiler Flue.

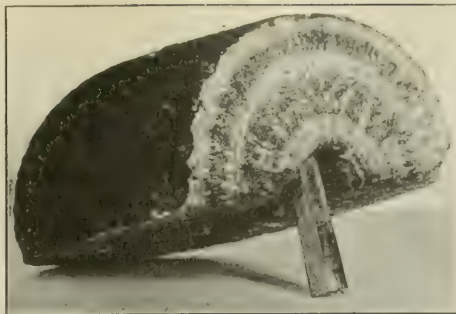


Fig. 4. Scale Deposited in a Condenser.

Plant Protection Institute Organized

With the advice and assistance of the National Research Council, a co-operative body of scientific experts on injurious insects and plant diseases and of manufacturers of insecticides, fungicides and general chemicals and apparatus used in fighting the enemies of field and orchard crops, has just been organized under the name of the Plant Protection Institute.

The purpose of the Institute is to promote the general welfare by supporting and directing scientific research on the pests of crops, shade trees and ornamental plants, and on the methods of their control, and by furthering co-operation between the scientific investigators and the manufacturers of chemicals and appliances, to the end of effecting standardization and economy in the production and use of the means of fighting pests. Also it expects to aid in the dissemination of scientifically correct information regarding the control of injurious insects and plant diseases.

Much excellent work along this line is now being done by government and state organizations, but a further advance can be made by introducing a wider co-operation of the efforts of both the scientific men and the manufacturers of control devices. It is in this general direction of co-operative work that the Plant Protection Institute expects to be most active.

A. E. Staley Mfg. Co., Decatur, Ill., manufacturers of starch, glucose and other corn products, has recently completed extensive improvements comprising a 3-story 100x200 syrup house, a 40x100 refinery building 127 ft. high, and a 128x77 bone black filter house 228 ft. high.

Louis Muench, formerly president of the Republic Chemical Co., Inc., whose assets and business have been acquired by the Vulcan Detinning Co., will continue to be identified with the detinning plant of the new organization at Neville Island, near Pittsburgh, Pa.

American capital is taking increasing interest in German industries. According to current reports about 1,000,000 marks in new shares in the Continental Rubber & Gutta Percha Company, of Hanover, the largest tire factory in Germany, has been purchased by the B. F. Goodrich Rubber Company, Akron, O. The German firm has enjoyed friendly relations with the Goodrich Company ever since pre-war times because the technical processes of the two concerns have been more or less exchanged and shared between themselves. These friendly relationships will be renewed and strengthened through the issue of new shares.

Integration in the Sugar Industry

The W. J. MacCahan Sugar Refining Co., of Philadelphia, has been acquired by the Rionda sugar interests. The refinery has a frontage of about 700 feet on the Delaware river and three wharves, as well as rail connections with the Pennsylvania and Baltimore & Ohio railroads. The company is capitalized at \$2,000,000, but the purchase price is understood to be far in excess of the nominal capitalization. The capacity is 3,000 bbls. daily requiring annually 1,000,000 tons raw sugar.

The purchase is significant of the changes that are occurring in the sugar industry and represents the integrating process proceeding from the producing end in contradistinction to the refining end of sugar manufacture. It was made by interests that are prominently identified with the producing end of the business, and was undertaken to round out their enterprises so as to embrace both producing and refining.

The Riondas are largely interested in several plantations in Cuba, including Tuinicu, Francisco and others. They are also actively interested in the Cuba Cane Sugar Corporation and Manati Sugar Co. It is understood, however, that title to the refining property will not be taken over by either of the two latter companies.

This is the fourth prominent movement on the part of well known sugar interests toward acquiring complete units in the sugar industry so as to include both refining plants and raw sugar production.

The first was United Fruit Co., which built its Revere refinery to take care of the production of centrals Boston and Preston. The next was the American Sugar Co., which bought central Cunagua and have in contemplation a new mill to be known as Joranu. The Warner Sugar Refining Co. in turn, a few months ago bought the Cuban sugar estates Amistad and Gomez-Mena.

These examples of an economic process while exhibited in a characteristic fashion in American industry long before the enactment of the Sherman anti-trust law, can be attributed largely to the restrictions of that measure.

While combinations of competing interests, with incidental potentiality to oppress the consumer, are under the ban, there is no restriction to the endeavor of industrial enterprise to attain greater efficiency by what we may term a vertical combination of contributory and consuming industries, in contradistinction to the *verboden* horizontal combination of competitors; at any rate, not until such combination acquires or displays monopolistic power.

Additional examples in the sugar field comprise consumers of sugar, which, like Loft, Inc., the Hire Root Beer interests, etc., have acquired sugar centrals and pay toll to refiners for handling their crude sugar.

Dr. Herbert Watson, Delaware State Chemist, has informed the Wilmington City Court that "real ripe buttermilk" contains 3 per cent. of alcohol and that every vendor of this beverage is liable to prosecution.

* * *

Dr. Henry S. Drinker has resigned from the presidency of Lehigh University, with which institution he has been connected since his graduation in 1871, serving in that time successively as secretary of the alumni, president of the alumni, alumnus trustee, trustee and president.

The Celluloid Industry of Japan

The manufacture of celluloid was begun in Japan in 1889 by Rokusaburo Kocho, who established works at Nakkanogo, in the vicinity of Tokyo, but it remained undeveloped until 1908, when two large factories were built by the Nippon Celluloid & Artificial Silk Co. and the Sakai Celluloid Co., respectively. The former were erected at Aboshi, near Kobe, and managed by Dr. J. L. Keen, an English expert, and the latter was conducted by Dr. C. Axtel, an American chemist, who chose a site at Sakai, near Ozaka. After initial difficulties both firms succeeded in marketing their products in 1910, but subsequently, owing to over-supply, severe competition took place between them. In 1914, after both works had reduced their output by one-half, the war materially influenced their prosperity.

The Nippon company received an enormous order for guncotton from the Russian Government, greatly increased the capacity of its works, and quickly made good the losses it had suffered during the previous years; at the same time the Sakai company obtained a monopoly of the supply of celluloid sheets and reaped great profits. Owing to the utilization of the celluloid factories of foreign belligerents for war-time services, the Japanese celluloid and camphor industries received a great impetus, many new plants were erected, and, in general, the industry was placed on a very sound footing.

In addition to the two firms above mentioned, there were at least ten others of considerable size manufacturing celluloid sheets. Toward the end of last year six of the latter amalgamated with the two pioneers to found the Dai Nippon Celluloid Co., with a capital of 12,500,000 yen. In addition there are a few firms, such as the Toa Celluloid Co., which supply raw sheets to the factories at which novelty goods are made.

The total annual production of celluloid sheets, rods, tubes, etc., is estimated at 6,000,000 lbs., of which two-thirds is consumed in the country for making novelty articles. Although it is not possible to give the number of makers of these goods, as much of the work is done domestically, it is very large; in the neighborhood of Tokyo alone there are over 700 works.

The most important manufacturing firms are the Nagamine, the Chigusa and the Central Celluloid Co., at Tokyo, and the Koyama and Sakai Celluloid companies, at Ozaka. In general, toys, dolls, etc., are made in Tokyo, and brushes, beads, etc., at Azaka.

Importation of celluloid sheets into Japan dwindled from 5,980 cwt. in 1910 to 4 lbs. in 1917, when the exportation of the native celluloid sheets and articles began and rapidly attained considerable proportions, the United States, Russia, British India and Australia being the largest importers of celluloid articles, and England, France and Italy of celluloid sheets.

The 20,000-barrel topping plant of the Atlantic Lobos Co. at Guayabalillo, Mexico, has been placed in operation. This plant was built by the Mexican subsidiary of the Atlantic Refining Co. and transferred to the Atlantic Lobos Oil Co., along with other property, when the latter was organized in September, 1919, as a consolidation of the Mexican properties of Atlantic Refining Co., and the Port Lobos Petroleum Co. This topping plant is of the most modern construction. Work on it has been under way for more than a year and a half. It is connected by pipe line with the producing fields of the Atlantic Lobos Company, lying about 20 miles inland.

Motor Gasoline from Heavier Hydrocarbons

Its Preparation by Various Cracking Processes—The Theory of Cracking—Notes on the Present Status of the Industry

By Fred W. Padgett

Assistant Professor of Chemistry, University of Oklahoma, Tulsa, Okla.

THE growing importance of the internal-combustion engine during the past decade has brought with it the attendant problem of fuel supply. While the production of motor fuel in the past has been ample, the data indicate that in the near future we shall be faced with the problem of augmenting the supply, or see a depressing effect upon the automobile industry or account of shortage. The Bureau of Mines, in a recent report on refining statistics, shows that the gasoline production in 1919 increased 10 per cent. over 1918. On the other hand, the number of automobiles registered increased 22 per cent. during the same period and the increase of 1920 will be of like order. The question therefore presents itself as to how it will be possible to meet the future demand for motor fuel even though gasoline stocks were increased during the past year. The problem is not now a serious one, but may become so in a very few years.*

There are several sources from which additional supplies of motor fuel may be expected. Benzol and toluol from by-product coke-oven plants may be blended with gasoline to give a very satisfactory product, while industrial alcohol is a product to fall back on, if necessary. Crude oil may also be derived from such kerogenous substances as oil shale and there are enormous deposits of the raw starting material in various parts of the country, especially in Colorado, Wyoming and Utah, from which the crude oil may be extracted by low-temperature carbonization, or a combination of this with ultimate high-temperature effect in the presence of steam to recover the by-product ammonia.

Petroleum consists essentially of a mixture of hydrocarbons which are in the main totally miscible with one another. Organic nitrogen and sulphur compounds are also present in varying amounts and occasionally oxygen compounds, as well as water and inorganic material in disperse form. When this complex of naturally occurring hydrocarbons is treated by dry distillation at atmospheric pressure, the hydrocarbons of lowest boiling point are vaporized first and come into the condenser followed by those of higher boiling point as the temperature rises. Varying degrees of fractionation will obtain depending upon the design of still and method of operation. From the point where gases first appear at the condenser outlet until the temperature in the still reaches approximately 625 deg. Fahr., the products secured are in the main natural—that is, they exist in the crude oil as such.

Cracking

Above this temperature, however, especially if the distillation is carried out slowly, what is known as "cracking" takes place and a distillate is secured, which upon redistillation will yield more gasoline and kerosene, their quality, however, in most cases, not being comparable with that of the natural products.

If instead of carrying out the distillation above the

625 point at atmospheric pressure in an ordinary still, one of special design is substituted, and if the operation is conducted at a pressure varying from 50 lb. to 150 lb., profound decomposition or cracking occurs and a yield of gasoline of 15 per cent. or more may be obtained, based on the original charge of residue, upon fractionating the pressure distillate secured. The residue remaining, and the pressure distillate which has thus been freed from gasoline, may again be subjected to the process and a further yield of gasoline secured, this being less than in the first case and decreasing upon subsequent treatments.

This process of cracking is a special application of the well-known phenomenon which occurs when organic compounds are heated to a high temperature, decomposition taking place and the molecule being broken down into compounds of lower molecular weight.

The Catalyst in Gasoline Production

Again, if a sample of the same residual oil be placed in a vertical still having a fractionating column or "tower" interposed between the still and the condenser, and the distillation is carried out at atmospheric pressure, with stirring, in the presence of anhydrous aluminum chloride, the latter acts as a catalyst to cause the decomposition of the oil into gasoline, giving a yield of 15 per cent. or more. This process is an illustration of the fact that chemical compounds, working at atmospheric pressure, may effect a result similar to pressure distillation.

Commercial Processes

The various processes for producing motor fuel from heavier hydrocarbons may be classified roughly as follows:

1. *The Pressure Still.* A "two-phase" cracking system. Examples are the Burton and Coast processes.
2. *The Pipe Still.* Generally a "single-phase" cracking system. Examples are the Greenstreet, Hail and Rittman processes.
3. *The Use of Catalytic Agents at Atmospheric Pressure.* This may include reaction both in the single-phase and the two-phase systems. An example is the aluminum chloride process, which is likely two-phase to some extent.
4. *Combinations and Modifications of Two or More of the Above Methods.* The cracking may be in either single-phase or two-phase system. Examples are the Dubbs, Jenkins and Bacon processes.
5. *Processes Involving Principles not Included Under the Above Four Headings, but Which May Involve Similar Apparatus or the Use of Pressure.* These methods may have either single-phase or two-phase cracking systems. Examples are the proposed processes of Cherry,² Coast,³ Ellis,⁴ and many other processes equally unique. In the first a bipolar high-voltage, oscillating, silent electric discharge is thrown across the vapors; in the second, hot gases are passed

*Presented at the union meeting of the Continent Section, American Society of Mechanical Engineers, and of Oklahoma Section, of the American Chemical Society, Tulsa, Okla. May 28-29, 1920.

¹U. S. Pat. 1,229,886, Jan. 12, 1917, and 1,327,023, Jan. 6, 1920.

²U. S. Pat. 1,252,401, Jan. 8, 1918, and 1,261,215, Apr. 2, 1918.

³U. S. Pat. 1,295,825, Feb. 25, 1919.

through the oil or into contact with oil spray; and in the third, air is supplied to the cracking chamber where, by combustion with a portion of the oil, heat necessary for the cracking of the remainder is generated.

Patent History

During the past eight years numerous patents involving almost every conceivable form of apparatus have been granted for the purpose of securing hydrocarbons within the gasoline range from those of higher boiling point.⁶ Many of these patents seek to obviate the trouble incident to coke deposition, while others have the object in view of producing a gasoline which is comparable in quality with the natural product. Still others are along entirely new lines.

As early as 1865 James Young, the Scotch industrial chemist, secured a patent for the production of illuminating oil by means of pressure at about 20 lb. per sq. in.

The Pintsch gas process for the production of illuminating gas from gas oil dates back to the seventies in its commercial applications in the United States. As usually carried out at atmospheric pressure, the oil is passed by gravity into cast-iron retorts heated to bright redness. In the upper chamber of the retort oil is vaporized, while in the lower one cracking takes place. The vapors then traverse a tar seal, condenser, purifier, and meter, and are stored in a gas holder at a pressure near that of the atmosphere. The gas is finally compressed to 12 or 14 atmospheres in heavy welded tanks ready for delivery. One gallon of gas oil will produce from 60 to 75 cu. ft. of gas and when the product is compressed at the last stage a liquid known as "Pintsch gas drips" collects to the amount of about 2 or 2½ gal. per 1,000 ft. of gas compressed. This liquid, while quite volatile, is very unsaturated and entirely unsuitable as motor fuel.

Benton's apparatus for the production of illuminating oils from residual oils was patented in 1886, but was never used commercially. A pipe coil within a furnace is heated to a suitable temperature while the oil is forced through at a pressure of 285 lb. per sq. in. or more. The products of the reaction are released into a vapor chamber, which in turn is in communication with a condenser. At the inlet end of the coil is placed a safety valve and at the outlet a stop-cock for regulating the pressure on the coil.

In 1890 a patent was granted Dewar and Redwood for an apparatus which differed from that of Benton, to be used in cracking Russian residual oil to illuminating oil, but was never applied commercially because of the introduction of the starting material as fuel and its subsequent rise in price. A retort disposed in a furnace has one end in communication with a dome, the latter also being connected to a condenser. Safety valve, pressure gage, charging line and receiver are also provided, and the condenser and receiver are held under pressure. It is proposed to fill the retort partially, to distill under pressure and to collect the distillate in the receiver. Dewar and Redwood do not state what pressure gives the best results.

The Burton Process

Burton's first patent was granted in 1913 and the process is extensively used at the present time by the

various Standard Oil companies. In 1918 it was estimated that 10 per cent. of the gasoline produced was by cracking, a large proportion of this being through the Burton still. The development of this process marks one of the milestones in the history of petroleum refining and its originator merits the distinction of being the first to demonstrate that pressure distillation could be done safely and practically on a large scale. In addition, Burton realized the limitations of the type of apparatus and did not attempt, in the original design, to make the operation continuous.

The original claims of Burton consisted in the distillation of petroleum under a pressure of 4 to 5 atmospheres and a temperature of 650 to 850 deg. Fahr., maintaining the pressure upon the volatile products until they had traversed the condenser.

The standard Burton apparatus includes a still of 200 bbl. capacity or more, of conventional shape, so constructed that high pressures may be used. Beyond the condenser is located a safety valve which prevents the pressure from rising above a desired maximum and permits the escape of the permanent gases. Next in line is a valve where the pressure upon the distillate is released before it enters the run tank.

Modifications of the original Burton process call for introduction of the oil in the vapor line,⁸ amounting to semi-continuous operation, the use of false bottoms⁷ upon which the main portion of the carbon collects, and lastly a still containing internal flues.⁸

The Design and Operation of Pressure Stills

At the temperature at which the pressure still operates steel begins to decrease in tensile strength. It is therefore evident that a fundamentally important consideration lies in the material and method of construction of the stills. As an outgrowth of this need there are now firms which specialize in the construction of stills for severe usage. The walls of the stills are ¾ in. ⅝ in. thick and hammer-welded, this method of construction being claimed as superior to both riveting and to acetylene or electric welding for the purpose in view. In the operation of pressure stills the operator has before him thermometers and pressure gages, which inform him of the conditions prevailing within the various units under his control.⁹

In the operation of some pressure stills using gas oil as the starting material, the distillation is continued at the average rate of 1 to 2 per cent. an hour and the run is completed in 48 hours, giving a yield of 35 per cent. of 450 deg. Fahr. end-point gasoline. During distillation the bottom of the still is watched and if "hot spots" develop due to superheating from deposited carbon, close surveillance is maintained in order to determine if it will be necessary to close down the still before the run is completed. After each run the deposited carbon is completely removed from the still before recharging.

The Greenstreet, Hall and Rittman Processes

These processes involve cracking mainly in the vapor phase. By the Greenstreet method¹⁰ a mixture of oil vapors and steam is passed through a coil of pipe which is heated, the products next being permitted to expand in drums of considerable size. The pressure is released at a point between the expanding drums and the condenser. The Hall process¹¹ in a broad way re-

⁶U. S. Pat. 1,190,464, Sept. 26, 1916.

⁷Humphreys patents 1,122,002 and 1,122,003, Dec. 22, 1914, and 1,119,700, Dec. 1, 1914.

⁸Clark patents 1,119,496, Dec. 1, 1914; 1,120,024; Feb. 16, 1915, and 1,132,163, March 16, 1915.

⁹Liquid meters are sometimes placed on the run lines.

¹⁰*Petroleum Age*, 6 (1919), 66.

¹¹*Lomas, Jour. Inst. Pet. Tech.*, 3 (1916), 36.

⁵Some of the principles involved are as follows: The use of molten metal as a cracking agent; oil may be sprayed against an electrically heated plate within an autoclave; a perforated basket charged with metallic turnings may be disposed in a furnace; oil vapors may be subjected to progressively increasing and then progressively decreasing temperatures; superheated steam; various methods utilizing electric discharge across vapors; emulsified oil as starting material, etc., etc.

sembles that of Greenstreet but has the fundamental difference in that steam is not used and the pressure is released as the products leave the coils and enter the expanding drums. In the Rittman process¹² the cracking takes place in an upright tube containing a rod and chain, the latter being thrown against the sides of the tube when the former is revolved. The oil is fed into the tube at the top while the vapors are taken off separately from the tar pot at the bottom. All of these processes include the use of pressure.

The Aluminum Chloride Process

The most conspicuous developments under this method¹³ have been carried out by McAfee of the Gulf Refining Co.¹⁴ The oil is heated and stirred in a still in the presence of anhydrous aluminum chloride or other anhydrous salt of aluminum. Before treatment the oil must be freed from water and a quantity of the catalyst equal to a maximum of 8 per cent. by weight of the charge is added before the distillation is begun. Fractionating towers are interposed between the still and the condenser so that the higher-boiling vapors may be returned to the still along with aluminum chloride which has been vaporized and carried out. The distillation is continued slowly at a temperature of 500 to 550 deg. Fahr. over a period of 24 to 48 hours. By this method a yield of gasoline of 15 per cent. or more may be obtained from residual oils.

Very interesting in connection with this process is the effect upon the residue remaining in the still and the character of the distillate secured. At the end of the distillation it is found that the aluminum chloride is in mechanical combination with granular coke which is easily removed, and that a heavy oil free from asphalt, and with its viscosity in no way impaired, may be separated from the coke and then utilized for the production of high-grade lubricating oils, the recovery of paraffin wax, or the manufacture of petroleum. The distillate secured by aluminum chloride treatment is water white and processes a pleasant odor, and in order to secure the finished gasoline it is only necessary to wash the "re-run" distillate with dilute alkali and water.

By the action of anhydrous aluminum chloride on residual petroleum, sulphur compounds are destroyed and possibly nitrogen and oxygen compounds such as naphthenic acids as well.

The one difficulty suggesting itself as being inherent in this process is that of recovering the aluminum chloride, or of manufacturing it cheaply. McAfee has patented the two following methods for the recovery of the catalyst:

By the first method the aluminum chloride present in the coke is dissolved in water. The solution is then evaporated and heated moderately, when the hydrated salt is broken up into aluminum and hydrochloric acid. The alumina, when mixed with carbon and calcined in the presence of dry hydrochloric acid gas, reacts to form aluminum chloride, hydrogen and oxides of carbon.

By the second method the residual coke is heated in an atmosphere of chlorine, when the anhydrous salt is volatilized and carried away by the chlorine vapors.

Finally, it is of interest to introduce one of McAfee's tables on the treatment of 34 deg. Baumé Oklahoma crude petroleum, showing the comparison of the aluminum chloride process with that of the customary method.

	Per Cent. of Crude Oil:	
	AlCl ₃ Process	Usual Process
Gasoline	34.82	12.50
Kerosene	29.47	41.00
Gas oil	5.36	35.00
Residual oil	14.07	9.00
Sum of products	83.72	97.50
Loss	16.28	2.50
	100.00	100.00

While the above table is not representative of the actual amount of gasoline procured at the present time from the average Oklahoma crude petroleum, still the data may serve for making comparisons. At this time the average Oklahoma crude is being refined to about 20 per cent. of straight-run gasoline and 17 per cent. of kerosene.

Three methods which have recently come into prominence because of favorable reports concerning their operations, are those of Dubbs, Jenkins and Bacon.

Dubbs Process

The design and operation of the Dubbs plant is given in the report of a committee of the Western Refiners' Association to its members. Extracts from this report are quoted as follows: "The plant proper consists of a cracking coil made up of ten lengths of 4-in. extra heavy lap-welded pipe, each 20 ft. in length, jointed on the ends by return bends. This coil of 4-in. pipe is placed horizontally in a furnace in two rows, six of the pipes being in the lower row and four in the upper row. The furnace temperature is maintained at approximately 1540 deg. Fahr. The outlet of the 4-in. coil is connected to an expansion chamber which consists of four 20-ft. lengths of 10-in. common extra heavy pipe. These pipes are connected in series by means of return bends so as to form an expansion chamber approximately 80 ft. long. These 10-in. pipes are positioned horizontally in a chamber and are not heated, but insulated on the outside to prevent loss of heat by radiation.

"The raw oil is fed into one end of the 4-in. coil by means of a force pump, and as the oil passes through it is heated to about 820 deg. Fahr. and is then discharged from the other end into the 10-in. expansion pipes, which are maintained approximately half full of oil. The vapors are liberated from the oil and pass up through connecting goose necks to a manifold; then to vapor lines leading to a spiral vapor condenser, and finally into a water-cooled condenser. A pressure of about 135 lb. per sq. in. is maintained on the entire apparatus. The unvaporized portion of the oil in the 10-in. coil is continuously drawn off from the end of the last unit."

In regard to the Dubbs process, it should be noted that the cracking takes place in a two-phase system.

The following summary gives the results of a test run of 168 hours' duration:

Total gas oil treated.....	20,952 gal.
Total uncondensable gas.....	25,851 cu. ft.
Fuel used ¹⁵ —equivalent of 3677 gal. of 14 Bé. fuel oil.	
Products (per cent. yield of original oil charged):	
Gasoline (440 end point) (58.59 Bé.)....	26.29 per cent.
Kerosene (40-41 Bé.).....	14.11 per cent.
Pressure distillate bottoms (31-32 Bé.)...	27.19 per cent.
Residuum (13-14 Bé.).....	24.71 per cent.
Loss	7.70 per cent.

¹²Bureau of Mines Bulletin 114 and Technical Paper 161.

¹³Jour. Ind. Eng. Chem. 7 (1915), 757.

¹⁴Ibid.

Jenkins Process

In this process an apparatus is used resembling the water-tube boiler. The tubes in the latest installation are 2½ in. outside diameter, and cold-drawn. The furnace is of the vertical baffle type with Dutch oven, no heat coming in direct contact with either the longitudinal or traverse drums. The operation of the process is continuous and the oil is circulated mechanically. The safe limit of operation (with the type of starting material being used) has been found to be when a volume of oil equal to 14 times the changing capacity has been passed into the apparatus. Working under these conditions it is claimed that the still has long life and that the time of cleaning is only five minutes per tube. In closing down after a run the reduction of temperature is accomplished gradually by forcing more charging oil into the apparatus under complete mechanical circulation, thus eliminating undue stresses or strains which might be caused by a sudden temperature drop. Mr. Jenkins contributes the following data in connection with a run of 46 hours, using pressure distillate gas oil¹⁸ from Homer crude as the starting material:

Total oil circulated.....	17,130 gal.
Overhead pressure distillate.....	11,600 gal.
Fuel used—48,000 cu. ft. of city gas (natural).	
Products (per cent. yield of original starting material):	
Gasoline (118 I.B.P., 460 end point).....	24 per cent.
Kerosene.....	29 per cent.
Steam still bottoms.....	14 per cent.
Pressure still bottoms (52 vis. Saybolt at 100 deg. Fahr. and when treated, 4½ color)	27 per cent.
Total loss.....	6 per cent.

The pressure used in the above run varied from 105 to 110 lb. gage; temperature, 700 to 710 deg. Fahr.

The Bacon Process

This process was developed under the direction of Raymond F. Bacon and Benjamin T. Brooks at the Mellon Institute of Industrial Research. As originally designed some difficulties were encountered during operation because of coke deposition on the tubes; but according to the latest information certain improvements have made the process appear very promising. The "cracking" is carried out in a vertical tube 20 ft. in length and 6 in. to 19 in. in diameter, the oil level being maintained at the top of the heated zone and the process operated continuously. The oil inlet and vapor outlet are located at the top of the tube. The lower end of the tube is connected to a drum into which the tar and coke settle and are drawn off from a pipe at the bottom. When operating an apparatus of this type, coke accumulates very slowly on the metal surface in the cracking zone and in addition a large heating surface is exposed to the oil. The pressure specified is from 60 to 300 lb. per sq. in., but preferably 100 lb. The yields of gasoline (56 B.é.) claimed for various oils are as follows:

Oklahoma gas oil (32 B.é.).....	45 per cent.
Mexican fuel oil (12 B.é.).....	50 per cent.
California fuel oil (14 B.é.).....	47 per cent.
Caddo heavy crude (12-14 B.é.).....	48 per cent.

Deposition of Coke During Cracking

It has already been mentioned that one of the most serious difficulties encountered during "cracking" is the deposition of coke. Unless removed from the walls of the apparatus very soon after its formation, the coke produced becomes very hard and seems to unite

with the metal. Superheating (hot spots), consequent softening of the metal and finally "blowing out" may be the result of this condition. A majority of the processes include, among other things, methods of eliminating the coke from the heating surface. Thus the Burton process involves a modification in which false bottoms are used, the Rittman process a revolving rod and chain, the Bacon process vertical heating surface in the presence of liquid, and so on.¹⁷ One patentee specifies the use of steel balls which are passed intermittently through the "cracking" tube.

It is becoming the practice to utilize heavy distillates for the purpose of cracking rather than the residual oils. In this way the amount of coke produced during the operation is materially lessened. For example, a heavy asphaltic oil may be distilled to coke at atmospheric pressure and certain of the distillates used for the purpose of cracking.

Composition and Refining of "Cracked" Distillates

Unrefined "straight run" or "natural" gasoline distillates are composed of varying proportion of paraffins, naphthenes, aromatics, small percentages of olefines and a quantity of organic nitrogen and sulphur compounds generally small, but depending upon the character of the original crude petroleum. Oxygen compounds, such as naphthenic acids, may also be present in traces. Some of the straight-run gasolines which have been secured where direct steam was used in the distillation process necessitate little or no treatment with sulphuric acid.

The gasoline distillates produced by "cracking" contain diolefines in addition to the compounds mentioned above, while the proportions of aromatics are larger. Cracking in the vapor phase only, because of the higher temperatures generally employed, produces larger proportions of unsaturated hydrocarbons and aromatics than in the case of the pressure still.¹⁸ Cracked distillates upon standing may separate a resinous product which is derived, no doubt, from the diolefines and possesses explosive properties when heated.¹⁹ The disagreeable odor of these distillates is attributed by some to the unsaturated hydrocarbons, particularly the diolefines. Brooks and Humphrey,²⁰ however, record that this disagreeable odor is to be attributed more to the presence of organic nitrogen, oxygen and sulphur compounds.

Sulphuric acid acts both chemically and physically upon unrefined distillates, colloidal coloring matter being precipitated and dissolved by the acid, unsaturated hydrocarbons, nitrogen, sulphur, and oxygen compounds entering into reaction, the three last mentioned being by no means completely removed. The rise in temperature which is especially marked in the case of unrefined "cracked" distillates when treated with sulphuric acid is no doubt largely influenced by the diolefines.

According to Brooks and Humphreys, the lower olefines react to form alkyl esters, tertiary and secondary alcohols, some polymerization also taking place. Above the hydrocarbon C¹²H²⁴ polymerization takes place to form di- and tripolymers which contain but one double bond. Brooks and Humphrey also made the interesting discovery that the higher olefines such as

¹⁸Consumed during the run.

¹⁷It should be noted that this starting material has already been once through the process.

¹⁹In some refineries it is the practice simultaneously to agitate the oil slightly and to scrape the bottom of the still by means of a sweep with chains attached.

²⁰Where steam is used with the oil vapors, it is claimed that this condition does not obtain and that a sweeter product is obtained.

¹⁹See Ellis and Wells, *Jour. Ind. Eng. Chem.* 7 (1915), 1029.

²⁰Brooks and Humphrey, *Jour. Am. Chem. Soc.* 40 (1918), 822.

those found in the residual oils and in lubricating oils are but slightly reactive with concentrated sulphuric acid. In the case of gasoline distillates these polymers dissolve mainly in the hydrocarbon layer, raising the final boiling point. Likewise, neutral esters of sulphuric acid remain in the gasoline and are not removed when the product is washed with alkali solution; upon standing the product is likely to precipitate a resinous, viscous layer due to these esters.

It is well known that the "cracked" distillates are more difficult to refine successfully than the "natural" products. The loss is likely to be large and the resultant product may be colored. Ellis and Wells¹⁹ report that by hydrogenation of "cracked" gasoline was secured a water-white product, but they do not give the specific method used nor the constants for the gasoline before and after treatment.

Brooks and Humphrey²⁰ recommend that the unrefined product be treated with not more than 6 per cent. of 85 to 90 per cent. sulphuric acid, followed by redistillation.

Experiments Undertaken by the Author

In order to determine practical refining conditions for "cracked" distillates, as far as color, odor and stability are concerned, the writer and his students have carried out some experiments upon "cracked"

distillates from commercial pressure stills. Constants of the unrefined pressure gasoline distillate and the natural gasoline distillate, both from the same crude petroleum mixture, were determined as follows:

	Crude Straight-Run Gasoline	Crude Pressure Still Gasoline
Gravity, deg. Bé.....	57.7	54.3
Refractive index	1.4142	1.4252
Heat of reaction with sulphuric acid (1.84 sp. gr.) deg. Fahr.....	1	11
Loss of sulphuric acid (room temp.), per cent.....	9	16
Loss of sulphuric acid (32 deg. Fahr.), per cent.....	5	8

The experimental work undertaken upon the refining of "cracked" distillates has developed in such an interesting way that the work may be considered as only begun. The best results from the standpoint of both color and odor were secured by direct treatment of the pressure still gasoline with concentrated (1.84) acid at 32 deg. Fahr. followed by redistillation. The color of the product did not deepen after the sample had been exposed to the light (sunlight part of the time) for approximately 30 days.

Other most interesting results have been secured but it is not advisable to discuss them at this time until further experiment and verification.

Human Frailty and Chemical Nomenclature

THE report of the Metropolitan Life Insurance Company of 40 deaths among its industrial policy holders during the first four months of 1920 from wood alcohol poisoning incidental to the use of adulterated beverages, not only shows that at the present time wood alcohol poisoning is of increasing significance as a cause of death, but emphasizes the co-ordinate necessity of general preventative measures.

The importance of the extensive uses of this homologue of the less poisonous but more slowly insidious product that is under the growing ban among civilized peoples, requires that these preventative measures shall not hamper the numerous industries in which it is an essential raw material.

The legitimate uses of methyl alcohol may be grouped as follows:

- A. For denaturing ethyl alcohol.
- B. In the chemical industries: (1) as a solvent (fats, varnishes, moving picture films, etc.); (2) as an extraction agent (explosives); (3) as raw material for production of formaldehyde; (4) in synthetic chemistry for introduction of the methyl (CH_3) group (perfumes, flavors, dyes, etc.); (5) as a reagent in the laboratory.
- C. In pharmaceutical and medicinal preparations (surgical dressings, cattle medicines, etc.)
- D. In the arts and crafts (manufacture of incandescent mantles, of hats, furniture, pianos, burial caskets, boots and shoes).
- E. Unclassified (fuel, illuminant, cleaning fluid).

Obviously the preventative process must be an educative one and where such process is almost impracticable, as in a contest with ungoverned passion, the best that can be done is to remove the stimulus of suggestion present in the commercial nomenclature of wood alcohol.

The advocacy by Dr. Charles Baskerville, professor of chemistry of the College of the City of New York, of such change in the descriptive terms applied to

wood alcohol as would remove the temptation latent in a trade name suggestive of beverage spirits, is meeting with merited success. Dr. Baskerville says it should be the purpose of chemists and those powers influential in the transmission of chemical terms in the English language, to see that the word alcohol ceases its present significant use, at least in chemical literature.

Technically all alcohols should become known as -ol bodies or hydroxides, as menthanol, ethanol, propanol, butanol, methyl hydroxide, ethyl hydroxide, propyl hydroxide. This movement is already well under way, as producers of ninety per cent. of the refined methyl hydroxide in this country have decided that hereafter all packages containing it shall be labelled "methanol," and so their advertisements read in the trade journals today.

This change in nomenclature cannot be brought about instantaneously but will require time. The word will continue as a synonym in any event, although through concerted action, it may become more or less obsolete. No legislation can eliminate the name.

All producers, distributors and users of this valuable commodity can contribute to lessen the evil of its use as a beverage by calling the product by a name that carries no suggestion of the properties associated with ethanol.

When you think of wood alcohol say "methanol" and so label the container.

Southern Cotton Oil Co. will erect a \$10,000 addition to its Augusta, Ga., plant.

* * *

The Lone Star Brewing Co.'s plant at San Antonio, Tex., controlled by Augustus A. Busch, of St. Louis, Mo., will be converted into a 15,000-spindle cotton mill. The new enterprise will be organized at the Lone Star Cotton Mills capitalized at \$1,300,000.

Some of the New Applications of Sulfur in Agriculture

By Dr. Jacob G. Lipman

Dean and Director, New Jersey Agricultural Experiment Station



Dr. Jacob G. Lipman.

FINELY powdered sulfur may be used in a number of ways for increasing crop yields.* The functions of sulfur as a means for increasing the productive power of soils may be briefly considered under three heads, viz., (1) sulfur as one of the ingredients of plant food; (2) sulfur as a means for making available other plant-food ingredients, and (3) sulfur as a soil amendment.

Sulfur as a Plant-Food Ingredient

In considering sulfur as one of the ingredients of plant food it should be remembered that without sulfur there could be no plant growth, as is true of carbon or nitrogen or other constituents of so-called plant-food. The need of crops for sulfur will vary with the character of the crop. Generally speaking, cereals may require from four to six or seven pounds of sulfur per acre per annum. Clover, alfalfa and other members of the legume family of plants require more sulfur because of their higher content of protein. It may be assumed that a good crop of clover or alfalfa will require 8 to 15 pounds of sulfur per acre. Very heavy yields of alfalfa would require more. Certain cruciferae, especially cabbage and cauliflower, require even larger quantities of sulfur than the leguminosae. Heavy crops of cabbage may require as much as 30 or 35 pounds of sulfur per acre.

The sulfur requirements of crops are met by the sulfur reserves in the soil. Good arable land usually contains three to five hundred pounds of sulfur per acre to a depth of six or eight inches. Most of this sulfur is present in organic combinations—some of it in the form of sulfates. The soil resources of sulfur are supplemented by those contributed by atmospheric precipitation—usually from 6 to 10 pounds per acre per annum, although much larger amounts are brought down from the atmosphere in the vicinity of large industrial centers.

In considering the sulfur resources of crops, it should be remembered that, aside from the sulfur removed by the plants themselves, certain quantities of sulfur are removed

from soils in the form of sulfates. The soil is, therefore, constantly losing sulfur through the removal of crops and the carrying off of sulfates, largely calcium sulfate, in the drainage water. Studies in several sections of the United States show that land that has been under cultivation for some time is poorer in sulfur than corresponding land that is virgin or has been under cultivation only for a short time.

On account of the inadequate supply of sulfur in some soils, especially for crops of a certain character, the application of sulfur-carrying materials often leads to marked crop increases. This fact was recognized more than a century ago by progressive farmers in the eastern United States and Europe. At the end of the eighteen century land plaster was used rather extensively by progressive farmers in New York and Pennsylvania.

Since the wide introduction and use of so-called superphosphates, or acid phosphate, constituting mixtures of mono and dicalcium phosphate and calcium sulfate, the sulfur question in plant nutrition has not been prominent in the southern, the middle Atlantic and the northeastern states. On the other hand, farther west, where no superphosphates are being used, there are large areas that are deficient both in phosphorus and sulfur. Very striking results are being obtained in Oregon and Washington from the use of sulfates or elementary sulfur as a fertilizer on alfalfa. Elementary sulfur is, of course, preferable for this purpose to sulfates, particularly calcium sulfate, since it is more concentrated and, therefore, cheaper to transport and apply. It is recognized that the value of sulfur as a plant food depends upon its transformation into sulfuric acid and sulfates. The oxidation of sulfur into sulfuric acid is a biological process. Hence, the attention which is beginning to be paid to the use of suitable starters of sulfur-oxidizing bacteria. Inoculated sulfur is now being placed on the market by one or two of the sulfur companies.

Function of Sulfur in Increasing Availability of Other Plant-Food Ingredients

In considering the part that sulfur plays in increasing the availability of other plant-food ingredients, we should bear in mind that phosphorus and potassium are two of the three important ingredients found in commercial fertilizers. The enormous quantities of phosphorus used in American, European and Asiatic agriculture are derived in large measure from phosphate rock. Phosphate rock is ground to a fine powder and used as such to a limited extent. Most of it is treated with sulfuric acid in order that the tricalcium phosphate may be con-



Agricultural Building, Rutgers College Farm, New Jersey Agricultural Experiment Station, New Brunswick, N. J.

* Abstract of an address by Dr. Lipman before the New Jersey Chemical Society at its June 5th meeting at Rutgers College, New Brunswick, N. J.

verted into the more readily available dicalcic and monocalcic phosphate. There are being used in the United States an equivalent of two to two and a half million tons of sulfuric acid to produce an equivalent of four to five million tons of acid phosphate. Instead of using sulfuric acid for making available the phosphorus in phosphate rock, elementary sulfur in a finely ground state and inoculated with suitable sulfur-oxidizing bacteria may be used on the farm for the home manufacture of super-phosphate. Similarly, materials like greensand marl, containing the potash-bearing mineral glauconite, can be mixed with the sulfur in order that soluble potassium salts may be produced through the action of the sulfuric acid manufactured by the sulfur-oxidizing bacteria.

Sulfur as a Soil Amendment

Soil amendments are substances that do not in themselves furnish plant food, but improve the texture of the soil or in some other way favorably affect the soil environment of the plants. For instance, the use of sand on heavy clay soil, the use of clay on sandy soil is intended to improve the texture of the soil. Some materials may be both fertilizers and amendments. It is one of the functions of elementary sulfur to serve as a soil amendment in so far as the soil reaction is concerned. Certain fungi are troublesome in soil that is alkaline or only slightly acid. As the acidity of the

soil is increased these fungi become less troublesome and finally disappear. The fungus which is responsible for the scab of potatoes is a case in point. By using moderate amounts of inoculated sulfur, the acidity of the soil can be sufficiently increased to check injury from the potato scab fungus. Other fungi may similarly be suppressed as, for instance, certain of the fungi causing injury to roots of celery, field corn, sweet corn, etc.

There are many millions of acres of land in America and elsewhere that contain excessive quantities of sodium carbonate and bicarbonate. Such land is known as "black alkali" soil. It would seem that there are possibilities of reclaiming such black alkali soil by the use of inoculated sulfur. This material would serve as a means for transforming the injurious sodium carbonate or bicarbonate to the less harmful sodium sulfate. Other uses of inoculated sulfur have also been suggested and, in fact, farm practice is even now beginning to reckon with the possibilities of sulfur in speeding up production. The New Jersey Experiment Station has for several years been studying several phases of the sulfur problem and has accumulated data of interest and information. Part of the information as gathered has already been published; other information is to be made available for publication in the near future. The role of sulphur in the plant economy is a subject of growing importance.

Cellulose Symposium at the Chicago Meeting, September 7-10, of the American Chemical Society

Under the direction of Jasper E. Crane, now located in London as the European representative of the E. I. du Pont de Nemours & Co., a Cellulose Symposium was organized as a part of the program of the Division of Industrial and Engineering Chemistry at the St. Louis meeting of the American Chemical Society last April. One of the objects of this symposium was to ascertain whether a cellulose section, if formed, would secure the interest and support of a sufficiently large number of chemists.

The object of such a section would be to promote intercourse and co-operation between the chemists in the various cellulose industries. This group constitutes one of the largest and most important of American industries; all branches of it are intimately concerned in the problems of cellulose, and it seems highly desirable to promote technical activity in this country along these lines. The proposed section would serve as a clearing-house for papers and information on cellulose technology, and should also play an important part in promoting research on the chemistry of cellulose.

The symposium at St. Louis was distinctly successful. The interest shown was so great that it was voted to hold a second Cellulose Symposium under the auspices of the industrial section at the Chicago meeting, September 7-10. At this time the advisability of forming a permanent cellulose section will be considered. An interesting program is being arranged, and a large attendance of those interested in cellulose is anticipated.

Titles of papers or suggestions for the symposium should be sent to G. J. Esselen, Jr., 30 Charles River road, Cambridge, 39, Massachusetts.

H. C. Gunther has been appointed New York representative of the Monsanto Chemical works of St. Louis, Mo.

Expansion of Chemical Products, Ltd.

American representation in the directorate of Chemical Products, Ltd., the Canadian corporation developed out of the former Chemical Products of Canada, Ltd., Toronto, to take over the \$3,500,000 explosives plant at Trenton, Ontario, of the Imperial Munitions Board, comprise J. C. Graves, W. H. Vanwinckel and A. H. C. Heitman.

Mr. Graves is vice-president and general manager of the Saginaw Chemical Co., Saginaw, Mich., and formerly general superintendent of the Dow Chemical Co., Midland, Mich. Mr. Vanwinckel also formerly was with the Dow Chemical Co. as sales manager and more recently vice-president of Aniline Dyes & Chemicals, Inc., 134 Cedar St., N. Y. Mr. Heitman, formerly of Park Davis & Co., Detroit, will be general manager.

The shipping and manufacturing facilities of the former explosives plant at Trenton were noted in the June issue of Chemical Age, to which place the production of pharmaceuticals will be transferred from Toronto.

The capitalization of Chemical Products, Ltd., is \$2,500,000, of which \$2,000,000 is 8 per cent. preferred stock of \$100 par and \$500,000 common of no par value. \$500,000 of the preferred stock will be issued at once. With Canadian importation of chemicals in 1919 aggregating \$33,000,000, with a tariff especially designed to foster domestic manufacture and with convenient access to hydro-electric power and essential raw materials as phosphate and pyrites, to be used in the manufacture of sulphuric acid and acid phosphate, the new organization has great encouragement.

T. E. O'Reilly, Ltd., New York and Toronto, and Aniline Dyes & Chemicals, Inc., New York, will be sales representatives in the United States.

C. G. Robinson, president of the American Scientific Instrument Co., Inc., announces its removal from 50-56 John street to 70 Murray street, New York, where larger facilities are available for the manufacture of its general line of glass apparatus and laboratory supplies.

Patent Infringement Action of E. I. du Pont de Nemours & Co. Against the Hercules Powder Co.

WHILE E. I. du Pont de Nemours & Co. and the Hercules Powder Co. are distinct corporate entities, the large common stock ownership in both corporations imparts added interest in the chemical industry to a legal controversy over the right to the exclusive use of processes and materials in the manufacture of products which in recent years has come to be a business of amazing proportions.

The patents upon which the action was brought, it is claimed by the du Pont Co., protect the use of a mixture of ethyl acetate and benzol, with or without the addition of ethyl alcohol, as a solvent for nitro-cellulose. As pyroxylin solutions or dopes, used in the manufacture of split and artificial leathers, lacquers, cements, celluloid articles, and hundreds of other commodities, are commonly made by dissolving nitro-cellulose in these solvents, and as the two companies are among the leading competitors in the business, the interest of every one engaged in the manufacture of pyroxylin solutions, lacquers, artificial and split leathers and celluloid articles in this action is obvious.

Hercules Powder Co.

The Hercules Powder Co. was incorporated in 1912 in Delaware in pursuance of a decree of the U. S. District Court of the Delaware District in the action of the Government against the E. I. du Pont de Nemours Powder Co. In the unscrambling the Hercules Powder Co. took over a number of plants and a portion of the business of the latter company and, in payment for these properties, issued to it \$6,500,000 stock and all of its \$6,500,000 bonds. All of the stock and half of the bonds were distributed to the common stock holders of the parent company, and the remaining bonds have since been disposed of. The active business of the Hercules Powder Co. dates from Jan. 1, 1913.

The Litigation

The du Pont Co. claims that the patents, which are known as the Kniffen and Hitt patents, and are designated as Nos. 1,118,498, 1,135,026, 1,321,633 and 1,321,634, protect the use of certain solutions of ethyl acetate and benzol with or without the addition of ethyl alcohol as a solvent for nitro-cotton. This is approximately the pyrolin process and enters into the manufacture of the commodities hereinbefore enumerated.

The Kniffen patents cover a solvent for pyroxylin made by dissolving that material in ethyl acetate and benzol. The two Hitt patents cover practically the same ground, one claiming the solvent itself and the other the use of the solvent. The Hitt patents are more far-reaching than are the others, and are said to cover certain improvements on the processes discovered by Kniffen.

The Hercules Co. answers this claim by the assertion that the matters covered by the patents was common knowledge in the chemical industry before the patents were taken out and that the only reason ethyl acetate was not employed before was the availability and cheapness of other chemicals which could be used in place of it.

It is claimed by the defendant that the cheapness and availability of ethyl acetate brought about its use

in this process, which was understood and recognized long before it was put into commercial use.

Should the Hercules Powder Co. lose in this action the result would be a virtual monopoly of the use of ethyl acetate and, therefore, a monopoly of all pyroxylin solutions made with it.

The Lawyers

The patent law talent retained in this controversy comprises of Prindle, Wright and Small, 111 Broadway, New York, on behalf of the plaintiff, E. I. du Pont de Nemours & Co., and Frank S. Busser of Philadelphia and Pennie, Davis, Marion and Edmund, 35 Nassau St., New York, on behalf of the Hercules Powder Co.

Dr. David T. Day Heads Shale Oil Development Enterprise

The United States Producers Refining Co., Shreveport, La., has acquired 12,800 acres of oil shale land in northern Texas and will erect thereon a \$1,000,000 plant for the recovery of shale oil products. The company already has a plant of this kind at Santa Maria, Cal., where it is now planning to increase its facilities to handle 5,000 tons of shale daily.

T. H. Plumb, vice-president of the company, is on his way to Europe to investigate Scotch developments and processes with a view of utilizing them in connection with the system which the American company now uses. Dr. David T. Day, formerly of the United States Geological Survey and an expert on shale and its utilization, will be in charge. It will handle shale from which 50 gallons to the ton is the expected yield.

* * *

American Institute of Fertilizer Chemists Organized

On the occasion of the June meeting at White Sulphur Springs, W. Va., of the National Fertilizer Association, the representatives of about ten commercial laboratories engaged in fertilizer work took initial steps to effect a national organization of chemists identified with fertilizer manufacture and sale.

The officers of the temporary organization comprise Dr. F. Parker, of Charleston, S. C., as president; S. W. Wylie, of Baltimore, as secretary, and W. J. Gascoyne, Jr., of Baltimore, as treasurer.

A constitution and by-laws will be adopted and permanent officers chosen at a meeting to be held in Baltimore on August 2, at which time a full representation of commercial fertilizer chemists is expected.

* * *

Chemical Merger Coming to a Head

Negotiations looking to the merger of the General Chemical Co., Barrett Co., Semet-Solvay Co. and the National Aniline & Chemical Co. are reported to be progressing to the degree that the prices at which the shares of the subsidiary companies will go into the merger have already been agreed upon; and that the new company will have a capitalization of \$350,000,000.

It is understood that the aggregate earnings of the companies to be embodied in the merger are now running at the rate of \$30,000,000 annually, of which National Aniline & Chemical Co. contributes about \$12,000,000.

Recovery of Alcohol from Waste Sulphite Liquor

By Ralph H. McKee

Professor of Chemical Engineering, Columbia University

The Situation

Two cords of wood require as cooking liquor about 2,200 gallons of the solution of calcium bisulphite and sulphurous acid, and yield one ton of pulp.* On the completion of the "cook" the waste liquor ordinarily is drawn off, and discharged into the adjacent river to give rise to the vexatious problems of stream pollution. In other words, half of the wood goes to make paper pulp and half is dissolved by the cooking liquor and discharged into the river.

The total solids of the waste sulphite liquor average about 10 per cent, the principal portion being a calcium ligno-sulphonate produced by the solvent action of the cooking liquor on the lignin materials which bind together the cellulose fibers of the wood. This waste liquor also carries a small percentage of sugar. The amount of this sugar, apparently dextrose and fructose, varies from 1.5 to 3% depending on the temperature at which the wood chips have been cooked.

The utilization of this liquor in the United States is impelled by legislation forbidding the discharge of sulphite waste liquor into water courses. Pennsylvania and Wisconsin already have passed such laws, and there is similar legislation before Congress at Washington. So far as I know none of the Canadian legislatures as yet have taken action, but one cannot tell how long they will continue to hold off.

Lime or Ekstrom Process

For over half a century attempts have been made to utilize this sugar for the commercial production of alcohol. Only in the last ten years have successful methods been worked out.

One method is to heat the sulphite waste liquor with lime sludge or lime, filter off or decant from the precipitated calcium sulphate and calcium sulphite, and ferment the resulting filtrate, after the addition of yeast and yeast foods. The alcohol obtained on distillation of the fermented liquor carries a small percentage of wood alcohol (up to 3 per cent), and minor percentages of other materials which, though small in amount are sufficient to prevent the sale of the product as alcohol of the highest grade, unless exceptional care is taken in the distillation.

In 1918 this process, known as the lime or Ekstrom process, was used in Norway and Sweden by fifteen plants; in Germany and Austria by twelve plants; and in the United States by one plant. The yields of alcohol are generally lower than would correspond to the sugar content of the sulphite waste liquor. The explanation of the low yield commonly given is that it is due to the effect, in the neutralization step, of a local excess of lime on the sugar, it being well known that hexose sugars are readily destroyed by alkalis.

The total production of alcohol from sulphite waste liquor in the above mentioned countries in 1918 was approximately 6,000,000 gallons, most of it being used as automobile fuel. In the United States this process has not proven to be especially profitable, because of the low yields, high installation cost and the extreme care and skill required in its operation.

Disadvantages of Lime Process

The lime process has a number of disadvantages the principal ones of which are:

(1) The high lime requirement amounting in the case of a hundred-ton plant to four tons a day, or a yearly cost of \$1,800.

(2) The extra labor required to handle the incoming lime, to slake the lime and to handle the outgoing sludge.

(3) The loss of sugars, due to the action of the lime, amounts to approximately 10 per cent and, accordingly, means three cents a gallon increase in the cost of alcohol production, and a decrease in income from sales, if alcohol is sold at 60c a gallon, of \$36,000 a year.

(4) Sulphite waste liquor neutralized with lime carries a cloud of suspended solids even after settling and decantation.

(5) The residual slop from the alcohol still is not in good condition to be evaporated for use as a fuel.

(6) Scale formation in the case of the lime process is very rapid in the still. I have seen gypsum scale over half an inch thick on parts of a still working under the lime process.

The New Process

The second process arose about two years ago out of certain experimental work carried on in the chemical engineering laboratories at Columbia University, which showed that the common belief that sulphur dioxide and sulphites are poisonous to the yeast organism is incorrect. That these do prevent the growth of the yeast organism in many liquors is true; but our evidence is that this is due to the fact that they are reducing agents and use up the dissolved oxygen of the liquor rather than that they have any direct action on the yeast organism. If this explanation is true, then by bubbling oxygen or air through the liquor the effect of the sulphur dioxide and sulphites, when present in but moderate amounts, should be counteracted; and actually this was found to be true.

Waste sulphite liquor from which a portion of the free sulphur dioxide has been removed ferments readily and rapidly in the presence of yeast and a current of air. If the sulphite liquor is used without the removal of a portion of sulphur dioxide, fermentation ordinarily will take place, but the speed will be slow. It is better to remove the excess of sulphur dioxide by steaming the liquor for a time. The process has been carried out, not only in the laboratory, using a few liters, but through the courtesy of the Hammermill Paper Co., Erie, Pa., in small commercial units. Our first fermentations at the Hammermill plant were on 3,000-gallon charges, and later we used 13,000-gallon charges. We installed a commercial size still capable of handling 200 gallons of 95 per cent alcohol a day, and proved that there were no complications in the distillation of the alcohol formed in the sulphite liquor by the new process.

Ratio of Waste Sulphite Liquor to Pulp

The amount of waste sulphite liquor commercially available, using the ordinary type of blow pit and washing by displacement, has been shown by tests

*Presented before the Technical Section of the Canadian Pulp and Paper Association, June 23, 1920, Sault Ste. Marie, Ontario.

conducted at the plant of the Hammermill Paper Co., Erie, Pa., to be on an average 1930 U. S. gallons per ton of pulp. In other words, actual tests have shown the previously used figures of 1,200 to 1,600 U. S. gallons per ton of pulp to be too low an estimate.

Utilization of Associated Products

As carried out by the new process the liquor, after removal of the alcohol, is essentially free from sugars and sulphurous acid, and accordingly is a product of a less obnoxious character if run into the water course. Moreover, it can be evaporated and used as fuel with advantage. As by-products of the alcohol process there is obtained some sulphur dioxide in a form ready to be used in the pulp mill acid system, considerable hot distilled water for use as boiler feed water (30,000 lbs. at 212 deg. per hour for a 100-ton pulp plant), and much warm water, to replace the use of cold water, for use in washing pulp. In calculating costs of alcohol manufacture (see table) no credit is given for any of these by-products.

In carrying out the new alcohol process most efficiently, the waste sulphite liquor in one step is evaporated to approximately half its volume. If this liquor, after distilling off its alcohol content, is concentrated to 30° Bé, i.e., a liquor of 50 per cent solids content, it can then be burned in a properly designed boiler plant, by means of the ordinary form of oil burner, by which it is sprayed into the furnace. This will give us for a 100-ton pulp mill, about 1,000 H.P. per 24 hours as power; besides approximately one and a half times the amount of low pressure steam required to concentrate, in triple effect evaporators, the waste liquor left after the alcohol distillation, to the 50 per cent solids content ready to be burned under the boilers.

Procedure of Recovery

The detailed method of operation is as follows: The hot waste sulphite liquor, draining off from the wood pulp in the digester blow pit, is run into a desulphurizing column about 16 feet high where it meets a counter-current of steam and has the larger part of its sulphur dioxide removed. The sulphur dioxide recovered in this way is taken to the absorption towers to be used in the manufacture of fresh cooking acid.

The hot desulphurized liquor then is concentrated to approximately half its volume in a thermo-compressor type of evaporator. The choice of this type of evaporator is determined by the fact that the waste sulphite liquor is essentially a colloid and accordingly boils at approximately 212° F. even when partially concentrated. This makes evaporation of such a material very cheap and requires but small installation expense. The liquor as it comes from the desulphurizing tower may be fermented without evaporation, but to do so means doubling the capacity of the fermentation tanks and the building containing them, and is not wise from standpoint of cost.

The hot liquor is next cooled counter-currently with water. The warm water thus produced has decided advantages over cold water in the pulp mill in the washing of pulp. The waste sulphite liquor at about 29°C. is run into the fermentation tank and hydrolyzed yeast added, together with ammonium sulphate and calcium acid phosphate as yeast foods. A slow current of air is introduced through pipes leading to the bottom of the tank. The air current serves the double purpose of furnishing the required oxygen needed by the yeast, and of keeping the yeast mixed with all portions of the fermenting liquor. With fermenting liquors carrying large amounts of sugar, such as molasses, the carbon dioxide evolution is sufficient to keep the mass of the liquor stirred, but with fermenting liquor carry-

ing only a small percentage of sugar, such as waste sulphite liquor, the carbon dioxide evolution scarcely is sufficient to keep the yeast in thorough suspension.

After 60 to 72 hours fermentation the liquor is distilled, best in a continuous still, to give a crude alcohol, and this crude alcohol is then re-distilled in a discontinuous or batch still. On one of the upper plates of the rectifying column of the batch still, there is run a dilute solution of soda ash to neutralize the free sulphur dioxide which accompanies the alcohol in the distillation process.

Yield of Alcohol and Cost of Recovery

I have carried out fermentations using samples of sulphite liquor from about fifteen mills. The yields of 95 per cent alcohol vary between 0.55% and 1.35%, with an average of about 1.00 per cent calculated on the volume of waste sulphite liquor.

Based upon data obtained at the plant of the Hammermill Paper Co., Erie, Pa., in our fermentation and distillation of charges of 13,000 gallons of waste sulphite liquor, I give in Table I the costs of producing alcohol for a hundred-ton sulphite pulp mill. The percentage of alcohol given is 1 per cent, though the percentage obtained in the experimental work, using the 13,000 gallon charges mentioned before, was 1.07 per cent. The costs moreover have been increased to what I believe to be average Canadian costs.

Table I.

COST OF PRODUCING 95 PER CENT. ALCOHOL FROM WASTE SULPHITE LIQUOR.

Basis: 100 tons Sulphite Pulp per day, 300-day year; 1930 U. S. gallons of Waste Sulphite Liquor per ton of Pulp:

A. Power	
Evaporation, Desulphurization, 416 B.H.P. at \$100	\$41,600
Distillation, 85 B.H.P. at \$100.....	8,500
Pumping, 22 B.H.P., at \$70.....	1,540
Air Compressor, 20 B.H.P. at \$70	1,400
	\$53,040
B. Labor	
Superintendent at \$3,000.....	\$3,000
2 Stillmen, 65c per hr.	4,680
2 Desulphurization men, 65c per hr.....	4,680
2 Fermenting room men, 65c per hr.....	4,680
2 Laborers, 57½c per hr.	4,140
	\$21,180
C. Plant	
Buildings	\$145,000
Wood Fermenting and Storage Tanks, 11, 23' diam. x 20' high	25,000
Stills, Evaporators, Desulphurizers, Yeast Growing Equipment, Alcohol Storage.....	177,000
Piping	20,000
Motors and Pumps.....	8,000
	\$375,000
D. Cost of Manufacturing	
Horse Power	\$53,040
Labor	21,180
Yeast Food	15,000
Soda Ash	5,000
	\$94,220
E. Charges	
Interest on Investment, 8 per cent.....	\$30,000
Depreciation, Buildings, 5 per cent, Machinery, 10 per cent	28,500
Repairs	11,580
	\$70,080
F. Recapitulation	
Percentage of 95 per cent alcohol on original liquor	1%
Gallons (U. S.) 95 per cent alcohol per year.....	579,000
Cost per gallon Item D.....	16.27c
Cost per gallon Item E.....	12.13c
Total cost per U. S. gallon (not including royalty)	28.40c

Contribution of Fuel Value of Residuum to the Cost of Alcohol Recovery

At the April meeting in New York of the Technical Association of the American Pulp & Paper Industry, there was presented a paper on Fuel from Sulphite liquor (published in Convention number of *Paper*). Availing ourselves of the great advances of the last few years in boiler design and boiler practice and the burning of powdered coal and of oil, and using the data regarding concentrated waste sulphite liquor in the paper referred to, we have the simple and desirable utilization as fuel, of the residuum of the waste liquor after the removal of the alcohol by distillation.

When this residual sulphite liquor is evaporated we have the residue showing, on a dry basis for a typical liquor, a heat value of 7950 B.T.U. per pound and ash 13.9 per cent. The sulphur content of the residue is 5.4% and of the resulting ash 1.9%. For each ton of pulp there is obtained, after removal of alcohol, about 1,100 gals., i.e., 9,900 lbs. containing 14 per cent. solids, i.e., 1,386 lbs. To concentrate to 50 per cent solids will require the removal of 7,128 lbs. water, with the formation of a mobile pitch of 50 per cent solids, weighing 2,772 lbs.

Heat Value of Residue

B.T.U. developed by burning 1,386 lbs. of 7950 B.T.U.	11,018,700
B.T.U. required to drive off 1,386 lbs. of water 127,512 and 1,344,420 B.T.U.	1,471,932

Theoretically available B.T.U. 9,546,768

This is equivalent to 682 lbs. coal, 14,000 B.T.U., per ton of pulp made, or 34.1 short tons of coal per day for a 100-ton pulp mill.

If this pitch is burned under a boiler to give steam of 150 lbs. gauge pressure, there will be obtained a boiler efficiency varying between 60 per cent and 80 per cent, according to the design of the boiler and its firebox.

If 60 per cent, then per ton of pulp there will be obtained from water at 120°F.:

$$\frac{60 \times 9,546,768}{1,107} = 5174 \text{ lbs. steam at 150 lbs. pressure.}$$

If 80 per cent, then

$$\frac{80 \times 9,546,768}{1,107} = 6899 \text{ lbs. steam at 150 lbs. pressure.}$$

We may use the steam generated for the development of power in non-condensing steam engines. The exhaust steam of such engines could be used to evaporate the liquor in multiple effect evaporators. On the basis of this system we have the following:

A simple non-condensing Corliss engine, using steam of 150 lbs. pressure, has a steam consumption of about 25 lbs. per indicated horse power. Therefore from our steam we get—

$$\begin{aligned} &\text{With 60 per cent boiler efficiency} \\ &5174 \\ &\frac{24 \times 25}{6899} = 8.6 \text{ I.H.P. per 24-hr. day per ton of pulp.} \end{aligned}$$

$$\begin{aligned} &\text{With 80 per cent boiler efficiency} \\ &6899 \\ &\frac{24 \times 25}{6899} = 11.5 \text{ I.H.P. per 24-hr. day per ton of pulp.} \end{aligned}$$

The exhaust steam from this type of engine is at a pressure of 3 to 5 lbs. per square inch and is about 88 per cent dry. Assuming that owing to pipe condensation and other heat losses it delivers but 75 per cent of the theory to the evaporators, then with 60 per cent boiler efficiency we have.

$$\begin{aligned} &5174 \times .88 \times .75 = 3414 \text{ lbs. of steam per ton of pulp} \\ &\text{With 80 per cent boiler efficiency we have} \end{aligned}$$

$6899 \times .88 \times .75 = 4553$ lbs. of steam per ton of pulp.
To evaporate the 1,100 gallons to 50 per cent solids as calculated above will require the evaporation of 7,128 lbs. of water. A triple-effect evaporator of ordinary type will evaporate this amount of water if furnished 2,651 lbs. of steam, or a quadruple effect if furnished with 1,967 lbs. of steam.

If the boiler is of 60 per cent. efficiency then we have per ton of pulp an excess of steam above the requirements of the triple effect evaporator of 3,413 lbs. less 2,651 lbs. or **763 lbs.**

If the boiler is of 80 per cent efficiency, 4,553 lbs. less 2,651 lbs. or 1,902 lbs.

In other words for a 100-ton pulp plant, the fuel available will give, in addition to the energy required for the evaporation of the slop from the alcohol still to a concentration adapted to be burned from a nozzle, such as is used for burning fuel oil, the following:

If the boiler has a fuel efficiency of 60 per cent, 860 H.P. per 24-hr. day, and 76,300 lbs. low pressure steam; if the boiler has a fuel efficiency of 80 per cent, 1,150 H.P. per 24 hr. day, and 190,200 lbs. low pressure steam.

INVESTMENT REQUIRED TO EFFECT THE INDICATED FUEL ECONOMY.

Triple-effect evaporator to evaporate 30,000 lbs. water an hour, installed.....	\$75,000
Boiler 1000 H.P., installed.....	40,000
	\$115,000
15 per cent depreciation and repairs per year..	17,250
Labor, $2 \times 24 \times 65c \times 300$ days	9,360

Yearly cost of operation..... \$26,610

With H. P. year \$100 and coal \$8 per ton the income is as follows:

If boiler has 60 per cent efficiency:	
860 H.P. has a year value of.....	\$86,000
76,300 lbs. (3 lb.-steam) coal at \$8.....	5,232

Cost of operation \$91,232
26,610

Year credit value..... \$64,622

If boiler has 80 per cent efficiency:	
1,150 H.P. has a year value of.....	\$115,000
190,000 lbs. (3-lb. steam) coal at \$8.....	13,040

Cost of operation..... \$128,040
26,610

Year credit value..... \$101,430

If these values be credited against the alcohol cost, we have credits of 11.1c per gallon of alcohol if a boiler efficiency of 60 per cent is obtained; or 17.3c per gallon of alcohol if a boiler efficiency of 80 per cent is obtained. This leaves the net alcohol cost per gallon of 95 per cent alcohol of 17.3c, or 11.1c in the respective cases.

Black Diamond Products Co., capital \$50,000, has been incorporated by C. H. Alexander, John H. Ross and Raymond L. Smith, of Fairmount, West Va., to manufacture chemicals.

* * *

S. A. Neville, president and general manager of the Jackson and Eastern Railway, will instal a plant at Meridian, Miss., to manufacture turpentine and pine products from waste pine stumps.

* * *

Florida Sugar & Food Products Co., Towler Bldg., Fort Worth, Fla., has acquired the Lake Worth Fruit & Conserving Co. and will erect a \$50,000 community syrup mill and guava factory.

CHEMICAL AGE

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A Consolidation of
The Chemical Engineer
and Chemical Age



THE political recognition accorded a chemist in the economic laboratory of a young western state, is the highest yet offered in the annals of the utilization of technically trained men in public service.

Dr. Ladd's advancement from a teacher of chemistry and state chemist to the presidency of his institution, displayed not only the possession of administrative capacity, but an alert adaptability to an environment in sharp contrast to that which we term industrial.

His searching reports of analyses, and scathing comments of the labeling, of proprietary foods and technical products, are well known to factory chemists who supervise the manufacture of goods designed to comply with the Federal Food and Drugs Act and the progressive standards of the granger states.

The translation of Dr. Ladd's interest to public affairs was a logical step, particularly in a state where political experimentation has been most rife.

Chemists now should watch North Dakota to see if a man, who shares their academic origin, carries into politics that sound thinking which with rare exceptions invariably can be predicated of scientific training.

That Dr. Ladd had the support of the Non-Partisan League in his contest for a seat in the United States Senate, adds to the curiosity of an observation tinged with pride.

DR. MARSTON TAYLOR BOGERT'S declination of President Wilson's appointment as a member of the United States Tariff Commission, is not an expression of disinclination for public service on the part of a popular teacher of chemistry, but of a conviction that he could be of greater service to his profession and his country in his present work.

Dr. Bogert's exceptional experience in his profession and as a publicist, made his selection not only a commentary on the valuable functions of the Tariff Commission, but has set a standard for the prospective appointee.

This man should be a business chemist.

The basic character of the chemical and allied industries in our national economy requires, not that they shall be represented on the Commission, but that a man trained in this most pervasive science and skilled in its economic ramifications, should be appointed.

The business chemist is a political economist in chemical manufacture and so satisfies the conventional requirements.

THE reception accorded the American Institute of Chemicals Engineers on its Canadian visit, by political and industrial leaders in the Dominion reflects the appreciation of our northern neighbors of the value of the technical man in the utilization of their material resources.

The reduction of forest and mineral wealth to consumable forms and the elaboration of her agricultural products, are the work of technical men of which the chemical engineer is a group of increasing prominence as population and demand press back upon the soil and demand the fullest utilization of its products.

AT the Belleville banquet Dr. Olsen said that chemists, like "all Gaul," could be divided into three parts, viz., the analytical chemist who determines the constituents of matter, the research chemist who extends the realms of matter by increasing our knowledge of it, and the chemical engineer who applies the work of the analytical and research chemists to the production of goods.

Thus the work done by chemists provides a sharp line of demarcation in professional status.

Give to him in either the first or second group, executive capacity, the ability to get along with men, the power to realize a dream, and we have the entrepreneur of chemical enterprise—the chemical engineer.

David Wesson saw material for membership in the executives of chemical enterprises—that class of men who can seize upon a demand to create out of technical men a chemical enterprise, who can engineer chemists, who can give to circumscribed capacity its opportunity of expression, and so render valuable service to applied chemistry.

Dr. Olsen's estimate of 600 men in America qualified for membership in an aristocracy of capacity in chemical enterprise, either casts questionable reflection upon the results of chemical education in America and paucity of opportunity in the chemical industries, or expresses the policy of the membership com-

mittee to sacrifice comprehensive representation of ability in the highly diversified lines that embrace chemical work, to a coterie of congenial spirits always vulnerable to the innuendo that discrimination breeds.

IN his annual report of Columbia University, President Nicholas Murray Butler traces the movement of the center of gravity of a university's interest, and shows how such places of light and learning follow the styles that industry sets.

Fifty years ago, he says, the center of gravity lay in the classical languages and literatures, moving later to the social and experimental sciences, where it rests now in unstable equilibrium, with an unmistakable tendency to fall into those subjects demanded by the present needs of production, distribution and finance.

That Dr. Butler ranks chemical engineering with public law, international relations, public health, business administration, industrial and political economy, French and Spanish, indicates the drift of a decade's change and the value of technical education in human affairs.

TO the high specialization demanded of technical graduates in their respective fields, we are indebted largely for our intensive material progress.

This advantage not only has been at the sacrifice of their availability for broad lines of public usefulness, but is the basis of the charge that technical professional men have not the same standing and influence in their communities as men in other professions.

From the character of the service demanded and rendered, this charge will persist so long as concentration and devotion to an end are lauded as virtues, and the end is desirable.

To increase the usefulness of technically educated men to society—to widen the field of opportunity, the extension of the technical professional course to six years with a basic preparation in the humanities, is a general recommendation that Columbia and other institutions already have applied.

WITH defeat driven into the national consciousness and impotent from the need of food and raw material, the purchase of which is handicapped by economic restrictions which are a part of her penalty, Germany's present elimination as a trade rival in the markets of the world is at once an effect and a cause.

By her inability to engage in that multiform production, whereby her labor can be employed at a time when the world never was in greater need of it, and the national store of capital increased, can be explained her recalcitrancy to meet a debt in the creation of which Germany made herself the pariah of all time.

Remoteness from congested continental Europe, with its industrial, political and racial antagonisms, makes difficult for the American to appreciate the con-

flict in the minds of a fearful creditor who realizes that so long as the world is denied the productive genius of a great race, notwithstanding its moral obliquity, so long will distress afflict it.

AMERICA is suffering from arterio-sclerosis.

Truly, the failure of our transportation system to function in the needs of industry provides this physiological analogy which falls though when we recall that such disease afflicts only the aged; however, abuse and neglect may hasten its appearance.

The people are coming to realize that their public servants, notwithstanding practices incident to venture-some development, must be freed from restrictions that hinder their service.

Industry cannot grow and serve if its raw material and manufactured products cannot be transported.

A great emergency gave opportunity for the experiment of government management with results that forever has disposed of the incubus of government ownership of railroads.

With a rate that permits fair pay for efficient operation and ample means for maintenance and growth commensurate with that of private industry, we soon may expect an end to the strangulation of enterprise that now afflicts a prosperous country.

NOTWITHSTANDING reduced activity in certain extensive and widely scattered industries producing goods for personal wear as shoes and textiles whose distribution is affected most by the preaching of thrift and the scrutiny of profits, nothing in the general business situation, even in the face of the summer season and a national election, can support a conviction of early lower permanent price levels.

Tempted by reduced prices, restrained consumption relaxes only to advance them.

The precedent of depression following upon reaction from high prices does not apply, for we are emerging not from a period of construction and investment, but from an era wherein these activities have been absent; and are entering a period wherein they must be active if the wants of men are to be met.

With a growing standard of living; with high taxes penalizing production, but which the consumer pays, instead of based upon consumption; with so much delayed work, public and private, of every kind needing to be done; with high wages enforced by class action and scarcity of labor enforced by class legislation (restriction of immigration), and a philosophy of conduct on the part of organized labor that contradicts the general desire; with reduced labor in agricultural pursuits and population pressing ever faster upon the products of the soil whose price is set by the neediest of war sufferers, who can find a way to pay, not only are general lower prices remote, but their attainment will be a gradual process as the deficit in capital improvements of the war period is made good and the world resumes its normal contributions to the common needs.

Government Encouragement to Discovery of a Gasoline Substitute

Dr. Van H. Manning Discusses Representative Knutsen's Resolution to Encourage the Discovery of a Gasoline Substitute

REPRESENTATIVE (Minn.) Harold Knutsen's resolution introduced in the last Congress to appropriate \$250,000 to the Bureau of Chemistry to be used in the development of a gasoline substitute, noted in the June Chemical Age, drew from Dr. Manning, before his retirement as Director of the Bureau of Mines, illuminating comment in the form of a letter to Representative Knutsen, in which he explains that the logical administrator of such a fund, as it is proposed to disburse, is the Bureau of Mines, Department of the Interior, and not the Bureau of Chemistry, Department of Agriculture. Dr. Manning's letter follows:

I presume it is the intent for the Bureau of Chemistry, Department of Agriculture, to investigate the production of alcohol, ether and other chemical substitutes derivable from vegetable matter, and that it does not contemplate investigations of possible substitutes obtainable from heavy oils, oil shales, coals, and other mineral materials.

Mineral Kingdom the Logical Field for Research

The present situation of high gasoline prices and threatened shortage has been caused by an increase in the uses of gasoline faster than the increase in production and importation of crude petroleum, from which it is derived. We now find that we cannot obtain sufficient gasoline from the old processes of refining crude oil to meet the present and anticipated needs. Fortunately, however, processes have been developed in recent years for producing synthetic gasoline from the heavier and less volatile portions of the crude oils from which processes some 15 per cent. of the 4,000,000,000 gallons of gasoline produced in 1919 was derived. Synthetic gasoline can also be manufactured from oil shales, and gasoline substitutes are being manufactured from by-product coke ovens and can be made by low temperature destructive distillation of coals and lignites. I am strongly of the opinion that the problem of obtaining greater supplies of gasolines will be solved primarily by obtaining supplies from mineral matters, and that alcohol and other substitutes derived from vegetable matter can be but a minor factor in the situation for an indeterminate period of time.

Necessity for Research in the Petroleum Industry

Obviously the most satisfactory solution of the problem would be to obtain greater supplies of crude oil, and for this reason our government should give serious consideration to the encouragement of our nationals in acquiring supplies abroad. This government should also do its utmost to provide technical and scientific guidance for the industry at home for obtaining more supplies of oil from our own fields.

It is a fact not commonly known even in the oil industry that the wells obtain but a small proportion of the oil that exists in the sand, and that probably not more than from 10 to 20 per cent. is commonly extracted. Oil is found in the sands and sandstones

in pores which are almost microscopic in size. When a gas which forces this oil out of the pores of the sands is exhausted the remaining oil is held like water in a sponge and the well ceases to yield oil in commercial quantities, although a larger part of the 80 or 90 per cent. of the oil remaining can be obtained by the proper methods.

Some exceedingly promising methods have been used for a number of years which have proved indisputably that a great deal more oil can be obtained from our oil sands. But there are numerous important problems which will call for the best scientific and technical research for their solution before a full measure of our oil supplies can be obtained.

I am strongly of the opinion that one of the first considerations in insuring a future supply of gasoline should be of this 80 to 90 per cent. of the oil which is now being left in our oil fields, and that this government should properly conduct the necessary technical and scientific investigations and foster the use of improved processes in every way possible.

Synthetic Gasoline

Another problem which should receive immediate consideration is the manufacture of synthetic gasoline from heavy oils. At the present time there is only one process which is being largely used—the so-called Burton cracking process, held under patent by the Standard Oil Co. of Indiana. This process can use only one quality of oil, which is but a minor proportion of the heavier oils produced in this country.

Some 40 to 50 per cent. of all the petroleum which is now being used in a most inefficient manner for steam raising would be made available for manufacture into synthetic gasoline by the development of a commercially practical process for cracking these heavy oils into synthetic gasoline. The discovery of such a process available to all refiners might readily double the quantity of gasoline obtainable from our present production of crude oil and defer any apprehension of a gasoline shortage for many years to come.

Oil Shale Possibilities

In recent years vast quantities of shales have been found in the Rocky Mountain States, in California, Kentucky and many other states, from which can be obtained from one-half a barrel to over a barrel of oil per ton of shale. The U. S. Geological Survey estimates that the quantity of oil locked up in shales of Colorado, Utah and Wyoming is many times more than will ever be produced from our oil fields. From these shales gasoline and other petroleum products may be obtained by retorting and refining. This has been a commercial process for more than fifty years in Scotland. In fact, petroleum products were obtained in the United States from oil shales before the discovery of oil.

Although there is considerable interest and experimentation going on looking to the utilization of these enormous supplies of petroleum products in the West there are many problems to be solved before oil can be obtained successfully from shales. And to those who are endeavoring to develop this latent resource

there is need for the government to render every service and encouragement in the way of research and otherwise in order to hasten the date when oil from shales may be made available.

Benzol and Its Blends

A considerable quantity of gasoline substitute is now being obtained from by-product coke ovens. It is expected that 95,000,000 gallons of benzol will be produced in 1920, which will be about 2 per cent. of the total gasoline supply for the year. Everything should be done to encourage and foster this industry.

Still larger quantities of gasoline substitutes can be made by retorting the coals and lignites which are now being consumed as they come from the mines. If the available oil could be extracted from every ton of coal and lignite before they are consumed it would add very greatly to the supply of motor fuels, and I wish to point out here that the production of benzol from coal is likely to be inseparable from the utilization of alcohol from vegetable matter which you hope may be a solution of the motor fuel problem.

It is a fact that the present gasoline using engines cannot use straight alcohol satisfactorily, also it is going to be practically necessary that any substitute for gasoline as an engine fuel must be practically interchangeable with gasoline. To accomplish this purpose it is necessary to blend alcohol with gasoline. But alcohol will not blend with gasoline unless there is a considerable quantity of benzol or a similar product in the mixture. Therefore, unless some other solution of this problem is found it will be necessary to produce large quantities of benzol from coal in order to blend the alcohol with gasoline and make it an interchangeable fuel.

Alcohol from Sugar

At the present time but a comparatively small quantity of alcohol produced from sugar refinery wastes is being placed on the market in competition with gasoline. This is being sold as alcohol, benzol, ether and gasoline blends. However, the quantity of alcohol obtained from sugar refineries is negligible compared with our gasoline.

It is true that there are immense quantities of waste vegetable matter throughout the country, and were it possible to gather refuse from the farms and from

the lumber camps and other places a tremendous quantity of alcohol could be obtained, but it is unfortunately true that this waste vegetable matter is widely scattered and in few places is it concentrated enough that it seems commercially feasible to make alcohol in competition with gasoline.

The Most Promising Fields

From a quantitative standpoint petroleum, coal and oil shales are likely to be the cheapest raw materials for making gasoline substitutes. It must be borne in mind that the obtaining of gasoline substitutes alone will not solve the problems resulting from the failing petroleum supplies. Gasoline is but one of the essential products from petroleum. An automobile or farm tractor would be even more helpless without the lubricants obtained from the petroleum than without the gasoline. As you are aware there is not a moving part in any piece of machinery in the United States which does not require lubricants which are derived from petroleum.

Conclusions

I am strongly of the opinion that it would be a mistaken policy to limit the investigation of gasoline substitutes to vegetable matter and that emphasis should be placed on the investigation of the problems which I have mentioned.

I would therefore suggest that a serious consideration be given to encourage the development of gasoline and gasoline substitutes—

(1) by increasing the recovery of oil from our oil fields;

(2) by developing processes for making synthetic gasoline out of heavy oils;

(3) by encouraging the development of processes for making gasoline and gasoline substitutes out of oil shales, coals, lignites and peats; and

(4) by developing processes for making alcohols, ethers, etc., from waste vegetable matter.

In closing I would call your attention to the fact that with the exception of (4), such a program concerns primarily the Bureau of Mines, whose function is the investigation of mineral industries for the purpose of conserving the natural mineral resources and increasing the efficiency in the extraction and utilization of the mineral substances.

Coffee Publicity and Scientific Research

The Joint Coffee Trade Publicity Committee has signed a contract with the Massachusetts Institute of Technology authorizing the Committee to make use of the resources of the Institute for scientific research regarding coffee.

The work will begin immediately under the direction of Prof. Samuel C. Prescott, of the department of biology and public health, and will continue for at least one year.

The work will be done in the laboratories of the Massachusetts Institute of Technology at Cambridge. Prof. Prescott and his assistants will analyze the green coffee bean to determine the caffeine content; also the quantity and quality of volatile oils, tannic and other ingredients, especially astringent substances which give undesirable flavors in overdrawn coffee. Similar research will be conducted with roasted coffee, using both medium and dark roasts. Beverage coffees will be studied to determine the effect of the different degrees of granulation—pulverized, medium and coarse.

A study will be made also of the effect of water of different temperatures and of different degrees of hardness and methods of purification. The investigators will make coffee by the three standard methods of filtration, percolation and steeping, and determine the comparative amount of caffeine and other elements in the different brews. They will also study the effect produced by the addition to prepared coffee of hot and cold milk, of cream, of sugar, of salt and of soda. Experiments will be made to determine the best method of storing coffee, under conditions in which temperature, humidity and air supply can be accurately controlled. The Joint Coffee Trade Publicity Committee expects that with the results of this research in hand it will be equipped to conduct an even more aggressive campaign against the critics of coffee. It will have scientific facts to contradict charges based largely upon opinion and inconclusive evidence.

Colonel Amos Fries has been appointed by President Wilson to be Chief of the Army Chemical Warfare Service, with rank of General.

Cellulose Acetate—Its Manufacture, Uses and Properties

By Maurice Deschiens

Introductory

There are three cellulose acetates, according to the number of hydroxyl (OH) groups (1, 2 or 3) that are replaced by the acetyl radical, CH_3COO , in the cellulose molecule, probably $\text{C}_{12}\text{H}_{120}\text{O}_{60}$.

The reaction by which the mono-, di- and tri-acetates are formed is not a simple substitution, as in the case of the nitro-celluloses, but is considerably more complex, due to the formation of intermediate products and derivatives of oxy-and hydroxy-cellulose. In actual practice, therefore, the tri-acetate, which is the only important acetyl compound of cellulose, is never obtained pure.* The examination of various industrial acetates has shown that the properties, particularly solubility and viscosity, of these products, even when made in the same plant, are exceedingly variable. It also has been impossible to establish any definite relation between the physical and chemical properties of the acetates and their acetyl content. It is known, however, that the presence of sulphuric acid or sulphates in the acetates makes them unstable and reduces their solubility considerably.

Generalizations

The following observations have been deduced from the analyses of numerous commercial acetates:

1. The percentage of acetone-insoluble aceto-cellulose varies from 0.2 to 3.0 per cent.
2. The viscosity of acetone solutions, containing 6 per cent. of the product, varies from 5 to 90 at 15°C (30°Bé glycerine having a viscosity of 100 under like conditions).
3. The quantity of free acid, expressed in terms of acetic acid, CH_3COOH , varies from 0.01 to 1 gram.
4. The ash content is between 0.13 and 0.8 per cent.

As the free acid and ash content increase, the product becomes more unstable. Normal acetates decompose at 210 to 215°C , while the poorly made ones disintegrate at 176°C , or thereabouts.

The analysis of a typical commercial acetate from the "Usines du Rhône" follows:

Viscosity at 15°C (30°Bé glycerine=100).....	16.5
Insoluble Matter (acetone).....	0.2%
Free Acetic Acid.....	0.005%
Ash.....	0.18%
Moisture.....	5.3%
Temperature of Decomposition, initial.....	218°C
Temperature of Decomposition, complete.....	224°C
Acetyl Content (CH_3CO).....	43.08%

Acetylation

The tri-acetate is formed by the action of acetic acid or anhydride on dry cellulose. In order to start this hydrolytic action, there must be present in the mixture small quantities of inorganic acids, sulphuric or phosphoric, or compounds which liberate these acids, as zinc chloride, ammonium sulphate, potassium acid sulphate, methyl ammonium sulphate or copper sulphate. The reaction is endothermic and the rise in temperature is dependent on the nature of the dehydrating agent or catalyst that is used; 80°C , in the case of zinc chloride, potassium acid sulphate and ammonium sulphate. The reaction attains equilibrium

when the acetylated cellulose is completely dissolved. This is the homogeneous state in contradistinction to the heterogeneous state when the cellulose remains unchanged in appearance. Acetylation is entirely different from nitration, for in the former the action is slow and the ether formed is much more subject to the destructive effects of the acids. Furthermore, the acetates are soluble in the reacting liquids. The reduction of this solubility is of great technical and economic interest, as the less the solubility of the acetate, the smaller will be the quantity of acetic anhydride required to give a unit weight of the product, the more regular the acetylation and the less the opportunity for secondary reactions.

To bring this about, the addition of carbon tetrachloride has been proposed by Lederer. The process is interesting, for the boiling point of carbon tetrachloride ($83\text{--}84^\circ\text{C}$.) is sufficiently lower than that of acetic anhydride and acetic acid to make possible the recovery of these compounds by fractional distillation. In actual practice, the carbon tetrachloride is added at the end of the acetylation, causing the acetate to precipitate. After filtration, the precipitate is centrifuged and dried, while the filtrate is subjected to fractional distillation. Carbon tetrachloride may be replaced by benzene, petroleum ether, ordinary ether, and, in fact, by any liquid which will precipitate the acetate and is at the same time miscible with the constituents of the reacting solution.

The preparation of an acetylizing reagent is described in French patent No. 448,342 (1912), in which a mixture of acetic acid and acetic anhydride is obtained by the action of sulphuric acid on sodium acetate and the partial neutralization of the mixture by means of metallic acetates, or sulphur chloride, sulphur oxychloride, sodium sulphur oxychloride, etc. This reagent can be used directly without any further treatment.

Conditions Affecting Acetylation

The most important conditions from the manufacturing standpoint affecting acetylation are as follows:

1. Very careful selection of the raw materials (cellulose, acetic acid, acetic anhydride), which should be accurately analyzed before each acetylation, so that the proportions of the reacting mixture may assure a high uniformity of product.

2. Acetylation should be slow and regular, and the temperature should be controlled carefully, as the viscosity of the product is a function of the former conditions.

3. The hydrolysis and the conditioning operations should be conducted under constant supervision and frequent analyses should be made during their progress. The tests required are the solubility in acetone, the plasticity in hot chloroform and examination under a microscope.

Manufacturing Procedure

The processes of manufacturing cellulose acetate are divided into two classes:

- I. Acetylation of modified cellulose (hydrocellulose, oxycellulose, viscose).

- II. Acetylation of the natural cellulose (paper, cotton).

A distinction is also made between those processes

* *Chemical Industry*, Vol. 111, 5, pp. 571-607. Abstracted by Ismar Ginsberg, Aetna Explosives Co., New York City.

in which the cellulose dissolves in the acetylizing bath and those in which it does not.

I. Acetylation of Modified Cellulose

The Badische Aniline und Soda Fabrik has patented a process whereby cellulose is hydrolyzed by soaking it in dilute sulphuric acid and, after the hydrolyzed mass is separated from the major part of the acid solution, it is acetylated. The process is carried out in two ways.

1. Acetylation, with solution in the acetylizing bath.

100 parts of cotton, suitable for acetylation, are soaked with acidulated water, containing 4 to 5 per cent. sulphuric acid, for a sufficient length of time; the product then is pressed until it contains no more than 20 per cent. of dilute acid. After the hydrolyzed cotton is loosened up, it is introduced into a mixture of 400 parts acetic anhydride and 400 parts acetic acid. As the reaction is endothermic, care must be taken to maintain the temperature around 40° C. The completion of acetylation is indicated by complete solution of the cellulose. The product is precipitated by the addition of water, then washed and dried.

2. Acetylation, without solution in the acetylizing bath.

100 parts of cotton are steeped in an acid solution (60 per cent. sulphuric acid) and then pressed until its acid content is 10 per cent. The hydrolyzed cellulose is then mixed with 300 parts of acetic anhydride and 1,100 parts of benzene (the precipitating reagent). The acetylation lasts 12 hours, after which the temperature is raised and maintained at 60 to 65° C by means of a water bath, equipped with a reflux condenser, until test indicates that the acetate is soluble in hot chloroform. The product, which does not go into solution, is pressed, neutralized with sodium carbonate, washed and dried. In this process, the cellulose retains the texture and form of the original fiber.

In French patent No. 316,500, there is described the use of catalysts, such as ortho- pyro- and meta-phosphoric acids, or phosphorus pentoxide, in the acetylation of hydroxy- or oxy-cellulose. 100 parts of the cellulose are mixed with 400 parts of the anhydride, containing 1 per cent. of the catalyst, at a temperature of 40 to 50° C. These acetates have very little strength, and in this connection it may be mentioned that the less hydrolyzed the cellulose, the stronger the product.

II. Acetylation of Natural Cellulose

The modern industrial process of acetylating cellulose consists in treating dry bleached cellulose with acetic acid or acetic anhydride in the presence of a catalyst, usually sulphuric acid. The process is carried out in five steps and at different temperatures, according to the catalyst used.

A. Acetylation with Solution of the Cellulose Acetate

1. Acetylation.

100 grams of dry cellulose (French patent No. 358,079, (1915)) are placed in a mixture of 270 to 310 grams of pure acetic anhydride and 390 to 410 grams of crystallized acetic acid and 3 to 5 ccm. of the catalyst, 66° Bé sulphuric acid. The operation takes place in horizontal rocking mixers, furnished with special helicoidal-shaped paddles, which assure a vigorous and regular mixing, accompanied by a kneading effect. The mixers are jacketed, thus permitting heating or cooling. The bottom is made of bronze or aluminum; sometimes it is enameled. The capacity is about 300 to 600 liters.

At the beginning, the temperature is kept around 40° C, with constant mechanical agitation. When the mass has assumed an homogeneous appearance, the temperature is allowed to rise to 50-65° C, and is maintained at that point by means of a water bath until all the cellulose has dissolved. This takes from 36 to 48 hours and sometimes more. When a test sample is precipitated with water and dried, it should be soluble in cold chloroform and insoluble in acetone. When this point is reached the hydrolysis is started.

2. Hydrolysis.

A mixture of 60 to 65 ccm. of water and 60 ccm. of acetic acid, for every 100 grams of cellulose, is added gradually to the acetylation bath, carefully agitating the mass constantly. It is essential that no cellulose be precipitated during this process.

3. Conditioning.

The cellulose is removed from the mixers and transferred to others of the same type but of greater capacity, where it is conditioned (the acetylation being brought to a conclusion) at 40 to 50° C for 12 to 16 hours. During this operation, the hydrolytic action progresses uniformly and slowly, and the acetyl cellulose originally insoluble in acetone is converted gradually into the soluble form, while its solubility in cold chloroform diminishes. The explanation of the conditioning effect may be found in the greater and more complete division of the acetate molecule. It has been observed in the examination of samples of the product, taken at different times in the conditioning process, that the more tri-acetate contained in the sample the less granular and the more finely divided it was. As soon as the cellulose has acquired the requisite solubility and viscosity, it is transferred to the precipitation vats.

An acetate soluble in cold chloroform and insoluble in acetone indicates an insufficient conditioning. One insoluble in cold chloroform, plastic in hot chloroform and soluble in acetone indicates a finished product and a satisfactory content of the tri-acetate. If the conditioning is allowed to continue longer than necessary a complex mixture of acetyl derivatives of hydro-cellulose is obtained which, when precipitated, gives a powder whose solubility and other properties are very variable and entirely different from those of a good aceto-cellulose. Long continued conditioning produces a biose (cellulo-biose $C_{12}H_{22}O_{11}$).

4. Precipitation.

The acetylated mass is slowly agitated by means of mechanical stirrers in vats filled with a large excess of cold water in which a sufficient quantity of alkaline carbonate has been dissolved to neutralize the sulphuric acid. The acetate is precipitated in a white flaky mass. It must be washed and neutralized as completely and rapidly as possible, so as to avoid the hydrolytic action of the sulphuric acid, which results in the formation of acetates of lower molecular weight, less strength and of greater susceptibility to decomposition in storage.

5. Drying.

The aceto-cellulose is then air-dried, centrifuged and dried in large chambers, well ventilated and kept at a temperature of 20 to 25° C.

The theoretical yield of the tri-acetate from cellulose is 175 per cent., and this is approached quite closely in actual practice if the various operations are carefully carried out. As a rule, the yield is 135 to 145 per cent.

The duration of the different steps in the manufacture varies according to the nature of the catalyst

used. When zinc-chloride is used, the acetylation, hydrolysis and conditioning operations can be carried out at 65 to 70° C. With nitrosyl sulphate, the temperature is 70° C; with ammonium sulphate 50° C; with methylamine sulphate or aniline sulphate, 30 to 60° C, and with potassium acid sulphate, 80° C.

French patent No. 494,832 (1919) treats of a process in which the cellulose is subjected to a preparatory treatment which permits better penetration of the catalyst into the heart of the fiber. There are two ways of working this process, viz., (a) and (b).

(a) USE OF GLACIAL ACETIC ACID

1. *Preparatory Treatment.* 100 grams of cellulose are impregnated with 500 ccm. of glacial acetic acid and 5 grams of 62 to 66° Bé sulphuric acid and allowed to remain therein for 20 hours at 15 to 20° C.

2. *Acetylation.* 500 grams of acetic anhydride (80 per cent. strength) are added with constant cooling so as to keep the temperature at 40° C, until a clear solution is obtained.

3. *Hydrolysis. Conditioning.* After several hours 40 to 60 ccm. of 10 per cent. sulphuric acid are added and the mixture allowed to stand for 24 hours at 35° C.

4. *Precipitation. Drying.* This is carried out in a similar manner as described hereinbefore.

(b) USE OF WEAK ACETIC ANHYDRIDE

1. *Preparatory Treatment.* 30 grams of cellulose are soaked in 300 grams of acetic anhydride containing 40 per cent. of the anhydride and 60 per cent. of the acid for 16 hours at 16° C.

2. *Acetylation.* The temperature is raised to 25° C, with constant agitation so as to obtain a clear homogeneous mass.

3. *Hydrolysis. Conditioning.* 18 to 20 ccm. of a 10 per cent. sulphuric acid are added and the mass allowed to condition for about 24 hours at 35° C.

4. Precipitation, washing and drying proceed in the usual manner.

B. Acetylation Without Solution of the Cellulose Acetate

1. *Preparatory Treatment (U. S. Pat. 824,374).* 100 grams of cotton are treated with a mixture of 400 grams of pure acetic acid and 20 grams of benzene-sulphonic acid for several hours; the cotton then is pressed to remove half of the liquids and allowed to condition for 12 hours at 15 to 20° C.

2. *Acetylation.* The wet cellulose is acetylated by immersion in a bath containing 300 grams of acetic anhydride and 1,200 grams of benzol.

3. *Conditioning.* The mass is allowed to remain as above for 18 hours at 15 to 20° C.

4. The precipitation and drying operation are as usual.

Properties

The normal cellulose acetate, the tri-acetate, more or less mixed with the di-acetate, appears in the form of a coarse powder or rough amorphous fibers, whose structure varies with the cellulose used, the mode of operation, the conditioning and the conditions of precipitation. For example, the acetates prepared from wood cellulose are in general coarse, rougher and more viscous in acetone solution than those obtained from cotton.

The density of the tri-acetate is about 1.20. If an attempt is made to distill or volatilize it, it decomposes around 210° C. The higher acetates, unless they are

well washed and stabilized, decompose into the simpler ethers, setting free acetic acid, with decreasing solubility and increasing viscosity. The tri-acetate is less flammable and combustible than the nitro-celluloses; it appears blue when examined under the polarizing microscope (Mosenthal) and possesses a rotary power of about 14 to 16 (acetate made according to German patent No. 159,524).

Solubility

The commercial tri-acetate is totally insoluble in water, pure methyl alcohol, ethyl alcohol, butyl alcohol, ether, benzene, methyl-ethyl ketone, pure ethyl acetate, amyl acetate, tetrachlorethane, butyl formate, carbon-tetrachloride, toluene and triphenylphosphate. It possesses, however, the property of swelling up in contact with water, alcohols, benzene, butyl formate and methylethyl ketone. This property is particularly remarkable with water at ordinary temperatures and with the mixture of methyl and ethyl alcohol and benzene in equal parts around the boiling point.

In this swelled state, the acetate is much more sensitive to the action of certain solvents as acetic acid; it is completely saponified at ordinary temperatures by N-2 potash after treatment of several hours. It absorbs ordinary coloring matters, such as methylene blue, with great rapidity and in proportion to the degree of the swelling. This property is used industrially.

On the other hand, the tri-acetate is soluble in the cold in a large number of organic solvents, such as acetaldehyde, the acetals, acetone, formic acid, acetic acid, methyl formate, ethyl formate, methyl acetate, aniline, the phenols, the cresols, the benzyl and oxybenzyl alcohols, pyridine, quinoline, tri-acetin, cyclohexanone, the tartrates and citrates of amyl and butyl benzyl aldehyde, acetoacetic ether, ethyl oxalate, ethyl lactate, the acid oxalates and lactates, mesityl oxide, glycol diacetin, carvacol, carvol, eugenol, isoeugenol, safrol, isosafrol, the phthalic ethers, guaicol, creosote, acetamide, anethol and terpinol.

It is soluble in the hot in eugenol, furfurol, tri-acetin and chloroform. It is soluble at the boiling point in a solution of equal parts of methyl or ethyl alcohol and benzene. This property is used in the manufacture of cellulose acetate sheets and plastic masses (Sicoid, etc.).

It is interesting to note the fact that substances, which may be called auxiliary solvents, which do not dissolve aceto-cellulose by themselves, dissolve it very readily when there is mixed with them another non-solvent of cellulose acetate (ethyl or methyl alcohol, benzene), which are termed diluents. Such is the case with methyl-ethylketone, ethylacetate, tetrachlorethane, cold chloroform and butyl formate. In this way, if 4 to 5 per cent. of ethyl alcohol is added to ethylacetate, a non-solvent of cellulose acetate, the mixture can dissolve the acetate in the proportion of 1 gram in every 9 of the solvent.

Industrial Uses

I. Aeronautics

Prior to the development of aviation, cellulose acetate, because of its impermeability to gases, was used with success to coat balloon fabrics. Such a varnish, for example, was composed of 15 gr. cellulose acetate, 2 gr. caoutchouc and 100 gr. tetrachlorethane. The progress of heavier-than-air aviation has enhanced greatly the importance of acetate coatings.

These coatings are obtained by dissolving the tri-acetate in a mixture of more or less volatile solvents. This mixture consists of solvents with low boiling

points (50 to 60° C) called "light solvents" (acetone, methyl acetate, ethyl formate), combined with diluents (boiling point 80 to 115° C), which are ethyl or methyl alcohol and benzine, and solvents with high boiling points (130 to 200° C) called "heavy antipolishing solvents" (benzyl alcohol, phenol), which evaporate only slowly and partially.

On evaporation of the solvents is left an elastic film of variable thickness which must possess certain qualifications, viz., homogeneity, transparency, retractibility at the time of formation, elasticity, suppleness, tenacity, impermeability to water, castor oil and gasoline, the ability to increase the resistance of the fabrics coated with the film to tension and shear, to render the coated cloth stiff, and susceptible to a high polish which tends to reduce the coefficient of friction and thus to increase the speed of the aeroplane.

The standard formula for a coating made from cellulose acetate adopted by France and the Allies is as follows:

	Summer.	Winter.
Cellulose Acetate	80	80
Diluents and Light Solvents.....	860	890-880
Heavy Solvents (benzyl alcohol or phenol) (or Furfural 60)	30	40

The composition of the solvents used is as follows:

Acetone (light solvent).....	410
Benzine (diluent)	250
Alcohol (diluent)	220-230
or Methyl acetate (light solvent).....	513
Benzine (diluent)	250
Alcohol (diluent)	117-127
or Ethyl formate (light solvent).....	455
Benzine (diluent)	250
Alcohol (diluent)	125-175

The light solvents may be replaced by the following light auxiliary solvents in the ratio of 3 to 8: ethyl acetate, methylethyl ketone, butyl formate.

The mixture is applied in three coats (equivalent to a film of 70 to 80 grams per sq. m.) on the linen cloth, which has first been stretched on the wings of the machine.

Tension. The tensile strength of the fabric is measured by means of an apparatus called an aerotensiometer, which records the deflection produced in the stretched fabric by the application of a definite weight of saturant. This deflection is read off on a scale. Tests made with this apparatus to determine the strength of treated and untreated linen cloth gave the following results, expressed in mm.:

	Deflection
Untreated linen cloth	13.7 mm.
Same cloth with one coat of standard varnish (acetone and benzyl alcohol solution) represent- ing a film of 36 grams per sq. m.....	6.0 mm.
Same cloth with two coats representing a film of 56 grams per sq. m.....	4.9 mm.
Same cloth with three coats representing a film of 74 grams per sq. m.....	4.3 mm.
The minimum deflection is obtained with a film of 80 to 85 grams per sq. m.	

Impermeability. This is measured by reversing a framed film over a vessel of water and noting the number of days required for the water to penetrate the film.

Resistance to Tension. The linen cloth in its original state has a resistance of 1,500 kg. per linear meter both with and across the grain. A good varnish, applied in three coats and giving a film of 70 to 80 grams per sq. m., should increase this resistance from 25 to 50 per cent. The average of numerous tests gave: with the grain, 1,812 kg.; across the grain, 2,175 kgs.

II. Celluloid Industry—Plastics, Films

Because of the lower degree of flammability of cellulose acetate compared with cellulose nitrate, celluloids containing this compound in variable proportions have been made. A sample composition is as follows: (U. S. Patent No. 729990) 70 parts of nitro-cellulose, 30 parts of acetyl cellulose, and 50 parts of camphor. These non-flammable celluloids may or may not contain camphor, and the numerous formulae comprise cellulose ethers, various solvents, oils, casein, mineral pigments, etc.

The manufacture of plastic compositions from acetyl cellulose is closely allied to the celluloid industry. The principle involved is the solubility of cellulose acetate in acetone, its total insolubility in alcohol and benzine individually or mixed, and its ability to dissolve in a mixture of equal parts of these liquids in the neighborhood of the boiling point and to reprecipitate from solution in a gelatinous mass when the temperature is lowered. After this takes place, the supernatant liquid is decanted, camphor is added together with another plasticizing substance and the mixture is heated to 50 to 60° C, until a homogeneous mass is obtained, which can be moulded, cut and pressed. It can also be squeezed through dies to form threads or bars. It is used in the manufacture of imitation amber, ivory, etc., for combs, artificial flowers, etc.

The cellulose acetate sheets, used to make guards and unbreakable transparent plates for automobiles and aeroplanes, windows, etc., are obtained by mixing a paste of cellulose acetate with plasticizers and other substances as desired and then rolling the mixture out in flat sheets, compressing them in block presses, cutting them by means of special planing machines, called "cutting machines" of an automatic type and finally straightening them out again when hot by means of presses.

Cellulose acetate sheets, strengthened by an internal metallic center, are made in the same manner. These come into trade under different forms and are used for various purposes. They resist very well the action of the rain, snow and other atmospheric agents as they contain a considerable proportion of plasticizing materials and heavy solvents.

The manufacture of plates and films differs from that of plastic masses and sheets only in the mechanical regulation of the thickness of the films, the plastic material used and the application of a gelatinous sensitive coat.

III. Impermeable Fabrics—Washable Cloth

Certain kinds of impermeable fabrics are obtained by impregnating the fibers with cellulose acetate solutions. In the same manner, washable cloth may be made by passing the material through a 20 per cent. cellulose acetate solution and by the application thereon of a varnish of nitro-cellulose; or by the use of basic acetate of aluminum and after this has dried in the fiber, by the application of a cellulose acetate coating.

IV. Artificial Leather

Artificial leathers have been made from cellulose acetate. The backing consists of a suitable fabric on which the grain of the leather is imitated by appropriate means. The cloth is then impregnated with a mixture of cellulose acetate in suitable solvents, with tung oil, linseed oil, castor oil, to which are added pigments, fillers (chalk, kaolin, cork), and such substances as gutta-percha, oils and glycerine. Patent leathers are made by covering ordinary leather with one or more coats of a mixture, as described above.

V—Artificial Textiles, Artificial Horse Hair, Artificial Sponges

By processes which have been the subject of numerous patents a solution of cellulose acetate is made to pass through an orifice into a medium, capable of precipitating the acetate, whereby threads of cellulose acetate are obtained. These are used either to make artificial textiles, or as filaments for incandescent lamps, gas mantles (Welsbach type) or as substitutes for horsehair and bristles in brush manufacture (German Patents Nos. 123309 and 129420).

By mixing a cellulose acetate paste with fibrous materials and sodium chloride or sugar, and washing with water, artificial sponges may be made.

Artificial Silk

The manufacture of artificial silk with an aceto-cellulose base is the most important use of this substance, even though the industry is comparatively new.* There is a large number of mills making this commodity in the United States, Belgium and England.

These silks, e. g., artificial silks with a nitrocellulose base (Chardonnet), silks obtained by the solution of cellulose or hydroxycellulose in solutions of ammoniacal copper oxide (Parisian silks, Pauly-Glanzstoff), and Xanthate silks (Viscose), may be made in two general ways, as follows:

The Wet Method

The cellulose acetate in the form of a very viscous paste, mixed with suitable solvents and plasticizing agents which make the mixture very pliable, is forced through capillary orifices. The thread passes into a precipitating mixture, which throws the cellulose acetate completely out of solution and eliminates almost all of the solvents. For example, the cellulose acetate may be dissolved in acetic acid, phenol, etc., and the thread passed through a bath of alcohol. The thread, obtained in this manner, is combined with other threads by means of bobbins rotating at very high speed. This multiple thread is the final product

which can then be woven into cloth. The solvents can be recovered by distillation.

The Dry Method

The viscous solution of cellulose acetate passes continuously through very fine tubes into an air-tight chamber, heated to a temperature near the boiling point of the solvents used in the process. The semi-solid thread winds around a roller placed in the chamber and rotating very rapidly. The thread gradually solidifies as the solvent evaporates. Then the threads are combined and twisted on a bobbin.

The recovery of the solvent is a very simple operation in this case. All that is necessary is to treat the hot air, rich in vapors, by one of the modern recovery processes (Barbet-Bregeat-Claude, Clement Riviere R. D. S.).

The acetate silk is non-flammable, very brilliant and very supple. Its resistance to water is very strong, much greater than that of any of the other artificial silks made. It can be easily washed without deterioration. It is readily distinguishable from the other artificial silks by its density (1.25), its solubility in acetic acid, insolubility in cuproammonium solution and by the yellow color it assumes when treated with iodine and sulphuric acid.

VI—Insulators

In the electrical field, the use of aceto-cellulose as an insulator for wires, cables, etc., has been quite extensive, especially in the United States and England. The acetate is used either in the shape of a thread, which is wound around the cables, or in solution with a volatile solvent, which leaves an insulating coating of cellulose acetate on evaporation.

VII—Miscellaneous Uses

Among the miscellaneous uses of cellulose acetate, may be mentioned its use in compositions with certain explosives, the manufacture of cylindrical phonograph records, Bayco thread, capsules, lacquered paintings, certain kinds of adhesives and special cements, artificial pearls, and as a gelatinizing agent in the manufacture of solidified alcohol.

*Chemical Age, May, 1920, pp. 147-148.

Work on the Super-Power Plan Begins

WITH ways and means for increasing the production of coal under urgent discussion, the steps about to be taken to secure increased use of energy in electrical form, through the special investigations of the United States Geological Survey, are of strongly related importance.

The Survey's work, which began on July 1 under an appropriation of \$250,000, will represent the carrying out of a plan warmly advocated by former Secretary of the Interior Lane, and outlined at some length in his last annual report. Briefly stated, it contemplates a study of the power possibilities of the congested industrial part of the Atlantic Seaboard, looking to the building up of an interlocking system in the use of fuel and water for the generation and distribution of electricity in transportation and other lines of industry. The possibilities are believed to be enormous in the way of effecting economies and greatly increasing efficiency. Through the use of stationary plants there will be the enormous saving in the lifting of the burden

of coal transportation alone, for use in developing the power required to run many of the locomotives and individual power plants. Officials of the Government say there is the utmost need for utilizing the coal at stationary plants in the generation of electricity for motive purposes, while a plan for linking up this source of power with the available water power means wonderful savings and increase of energy, with great possible economies, throughout the "Boston to Washington" congested industrial region.

Headquarters of the force to make the investigations will be in New York City. Prof. L. P. Breckenridge, of Yale University, has been selected as chairman of the advisory board, while William S. Murray, consulting engineer, 165 Broadway, New York City, will be at the head of the engineering staff. The force, not all of whose members have yet been selected, will number some 25 or more experts. These will prosecute their studies throughout the current fiscal year, reporting results and conclusions from time to time.

When Will Building Costs Be Lower?

The Present Situation

By the Fuller Industrial Engineering Corporation, New York City

A GREAT many manufacturers and property owners have written us that they were considering new work, that they wanted to build and needed additional space, but hesitated to begin construction because building costs were so high. They have asked us "When will building costs be lower," and, with a view to counseling wisely with them, we have made a study of the situation.

Conditions Necessary for a Reduction

There are three conditions which might bring about a reduction in building costs: (1) A reduction in demand; (2) a reduction in wages of labor; and (3) a reduction in price of building materials.

A reduction in the demand for additional construction is highly improbable, in view of the present shortage of building space which has resulted from a slowing down of commercial and industrial building during the period of the war.

An inspection of the figures given herewith will bring out clearly the fact that the country at large is short about three and a half billion dollars' worth of normal building construction, and until this shortage is made up there will surely be continued and increasing demand for space.

As to the hope for a reduction in building costs due to a reduction in wages paid to labor, it does not seem probable that the laboring man will be content to accept any reduction in the size of his pay envelope. His attitude is rather to force wages to higher planes. An inspection of the diagrams which follow will show that the wages of the building trades throughout the United States, as well as in New York City, have risen steadily during the past seven years. Still labor is dissatisfied and restless.

The hope for a reduction in the cost of building materials rests very largely on the hope for a reduction in wages, because, for every dollar spent for brick, cement or steel which goes into a building, from 85 to 90 per cent. of such price ultimately goes back to the laborer who dug the clay, mined the coal, burned the brick, ground the cement, rolled the steel, and transported all of them over railroad lines to the site of the work and built them into the structure. Until these related wages go down, therefore, it is not reasonable to expect any substantial reduction in the price of building materials.

Some idea of the increase in the prices of the principal materials during the past seven years is given by diagrams. That this increase is by no means at an end is evidenced by the increase in prices of these materials since the first of January, 1920. In New York, the price of brick has risen from \$25 to \$33 per thousand; lumber from \$58 to \$72 per thousand feet, b.m.; steel from \$95 to \$135 per ton; and other materials in like manner.

In view of the building shortage in the United States, there seems little hope for a reduction in building costs due to reduced demand. With the present attitude of labor, there seems less chance for a reduction in building costs due to lower wages; and with this same attitude affecting 90 per cent. of the cost of building materials there seems small chance for a reduction in the price of building materials. The coun-

try is so far underbuilt that prices have become secondary to necessity.

We know of no other major influence which can bring a marked or immediate reduction in building costs, and our mature judgment is that there will be no substantial reduction for several years to come.

Our advice to our clients, in view of this whole situation, is that if they need additional building facilities, and the conditions of their business justify the expenditure, it is far wiser to build now and enjoy the benefit of the improvements than to wait and lose the use of this money-making space for several years, and then build at costs which may be even higher than those of the present time.

The Building Shortage in the United States

The records of new building construction in the cities of the United States, from 1911 to 1919, inclusive, as published by *Forbes Magazine*, shows the following figures:

TABLE I. RECORD OF NEW BUILDING CONSTRUCTION IN THE UNITED STATES, 1911-1919.

Year	Cost of Building Constructed	Average Cost per Square Foot	Square Feet Built
1911	\$ 962,499,700	\$1.59	605,300,000
1912	1,027,515,200	1.63	630,400,000
1913	980,971,600	1.61	609,300,000
1914	891,845,500	1.55	575,400,000
1915	931,937,300	1.52	613,100,000
1916	1,137,160,900	1.82	624,800,000
1917	816,941,000	2.27	358,500,000
1918	492,163,900	2.65	185,700,000
1919	1,467,821,300	3.20	458,600,000

The low average cost per square foot of building constructed, shown in the above table, is due to the high percentage of floor space which consists of the cheapest kind of factory construction, amounting to little more than sheds. The average cost per square foot of modern factories of reinforced concrete, or other fireproof material, as well as of first class office buildings and hotels, is much higher, the range being from \$3.50 to \$10.50 per square foot, depending upon the character of structure and its location.

For the years 1911 to 1914, inclusive, the estimated average amount of new building was equivalent to 605,100,000 square feet of floor space per annum. In 1918 less than one-third of this amount was done, and, even in 1919, in spite of the large money expenditure, the amount of building done was 146,500,000 square feet below this figure. Hence, it is clear that ever since the end of 1916 the available building space has been running further and further behind requirements.

Owing to the increase in population, at least 10 per cent. more floor space is required to be built annually than before the war. Otherwise, we ought to have built about 650,000,000 feet annually during the past three years, or nineteen hundred and fifty million (1,950,000,000) square feet in all. We actually built only about 1,002,800,000 square feet, and this leaves a shortage of 947,200,000 square feet. At the present time, we are building at the rate of about 550,000,000 feet per annum.

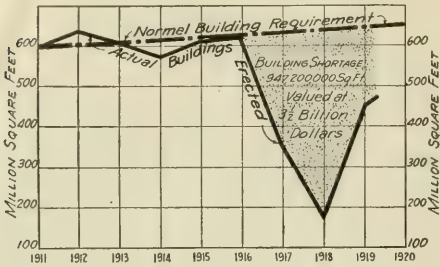


Fig. 1.—The Building Shortage in the United States.

Thus we see that in order to make up during this present year the existing shortage of housing space we would have to construct dwellings, factories and offices having an aggregate floor space of about 1,597,200,000 square feet, or almost as much as we ever built in any three past years.

Figure 1 illustrates graphically the normal building requirements in the United States from 1911 to the end of 1919, the actual building operations completed during those years and the resulting shortage which this country is now facing. The figures which are the basis for this chart are shown in Table I.

It appears, therefore, that we are about 18 to 21 months behind in our building program, and that the total amount of building operations during the next few years must not only rise to the average normal yearly requirements but must exceed those requirements sufficiently to make up the shortage which accumulated during the past three years. With this shortage to be overcome, there is no likelihood of a decrease in building operations, but on the contrary there is every reason to expect an increasing demand for some years to come.

How Long Will the High Cost of Building Continue?

We all know that prices are high, but it is interesting to learn *why* they are high and *when* they are likely to be lower. Some of the leading economic authorities of the day have studied these questions, and their findings have been published in the press. We quote from the conclusions of recent articles in the *Annalist*, *Forbes Magazine*, *Engineering News-Record*, and the daily press.

Why Are Building Costs High?

The prices of building materials and labor are controlled by economic law—supply and demand. The present abnormal demand for building materials is due to curtailment in the normal amount of building during the war; to a 10 per cent. increase in population since the war began; to a shifting of population from rural to urban centres, where thousands of men and women were attracted by war wages, which have increased, in many cases, since the war ended.

The labor shortage is due to the practical suspension of immigration since 1914; in a small measure to the return of foreign workmen to their own countries; to the stimulation of all manufacturing industries brought about by war conditions abroad; and very largely to the development in this country of entirely new industries, on a very large scale, such as dye manufacturing, ship building, etc.

The conclusions of economists furnish a criterion of interest:

Prices May Rise for a Year—Allen E. Beals.

"There is a startling similarity of opinion among building material manufacturers to the effect that the real peak of building material prices will not be reached until about the spring of 1921. From that period a price plateau is due to develop at which quotations may be expected to rule with almost unbroken fidelity for an indefinite time."

Two Years of Rising Prices—Frank Lord.

"By 1922 reason will be thrown to the winds and construction will be forced, regardless of cost, and real estate, houses and construction will be higher than in 1920."

Ten Years of High Prices—Allen E. Beals.

"The best advised men in the building material industry cannot see any reduction in demand for their products for the better part of a *decade*, and during that time they do not look for any marked reduction in building material prices."

Will History Repeat Itself?—Morris Knowles.

"In view of these conditions—namely, upward trend of prices previous to the war, difficult labor conditions, immobility of capital, foreign trade balance, price fixing and the protective tariffs—it is believed that the period of high prices will continue for a longer time after the present war than it did after the Civil War"—seventeen years."

Lowering of Prices to Be Gradual—Allen Nevins.

"But, in all, the country must face the fact that the accumulated demand for building is so enormous that any notable reduction in material prices for several years is unlikely. When reduction does come, it will probably be gradually, constantly regulated by the increased resumption of construction."

Wise Men Will Begin Building Now—The Annalist.

"Competent judges of the present building dilemma have felt, and have repeatedly emphasized their belief, that there can be no progress in the building construction enigma unless there is a complete realization on the part of architects, dealers, builders, building material manufacturers, owners, loaning interests and transportation companies that the costs of production have affected the scale of prices, and that the law of supply and demand has practically been suspended by the

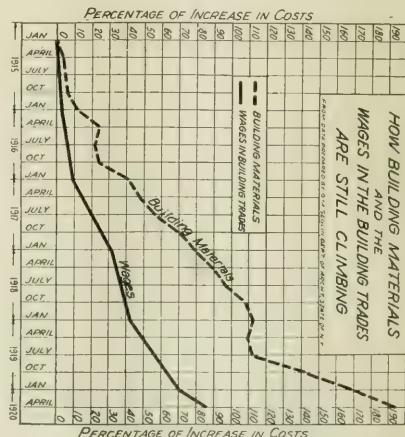


Fig. 2.—The Increase in Wages and Materials in the Building Trades.

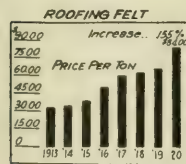
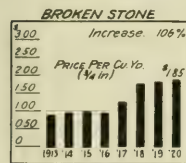
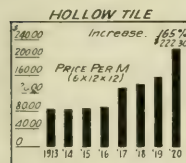
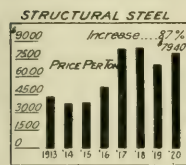
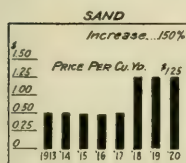
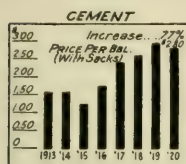
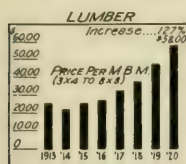
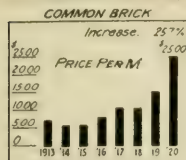


Fig. 3. Spring Prices of Building Materials in New York from 1913 to 1920.

manufacturer in favor of the builder. If the latter does not take advantage of the current quotations he is chiefly to blame if further delay occurs. Inactivity will tend to decrease production, and thus indefinitely keep prices at a level even above those now existing."

Conclusion

These authorities all agree that high building costs will continue for some time. They recognize, however, that any general financial depression will ultimately affect the cost of materials and labor, but feel that the decline in building costs will be small, and slow to follow the downward trend of other commodities, because of the great demand for building space which must continue until the shortage due to the war has been eliminated.

None of them anticipates a return to the low pre-war levels, and far-sighted executives are perfecting their plans and having exhaustive engineering reports made for the betterment of conditions in their factories, so that they can immediately take advantage of any lower costs which may momentarily prevail during the period of readjustment.

Many manufacturers, who see in the present prices obtained for their products an opportunity to write off the increased cost of new building, are going forward with their construction work, and are thus relieving their cramped factory conditions, securing greater production and lowering factory costs.

Synthetic Ammonia and Nitrates, Ltd.

The British Government's disposition of its war plans for nitrogen fixation takes the form of the most practicable encouragement of private enterprise consistent with assurance of its supply of explosives for war needs.

The British war effort in nitrogen fixation did not reach the degree of completion as regards the establishment and equipment of manufacturing plant attained by our government, and hence with consequent less encouragement to paternalistic plans for the production of fertilizers as a peace-time pursuit that there may be available in the emergency of war a government munitions plant.

Brunner Mond & Co., whose origin and growth form a large part of the history of the chemical industry of Great Britain, have organized the Synthetic Ammonia and Nitrates, Ltd., which has purchased from the government the site, with the unassembled material on hand, acquired by the government at Billingham-on-Tees during the war. Here, with a staff of technologists recruited from government and private service, will be built a fixation plant with an initial daily capacity of 100 tons of ammonia, equivalent to 150,000 tons of ammonium sulphate per year. The private corporation will have a capitalization of £5,000,000 under the control of a native British directorate approved by the government. The modified Haber process will be employed.

The Duriron Castings Co., 90 West Street, New York, has changed its name to the Duriron Co. Its capital stock was recently increased to \$600,000.

* * *

The Prest-o-Lite Co. will erect a new plant at Cincinnati, Ohio, on Brotherton Road between Oakley and Madisonville, where 16 acres have been secured.

* * *

The United States Fertilizer Co., Carrollville, Wis., will build a one-story brick and reinforced concrete addition, 100 ft. sq., costing about \$70,000.

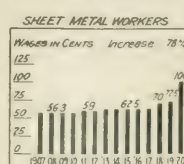
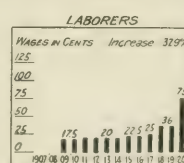
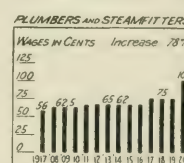
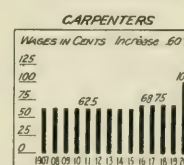
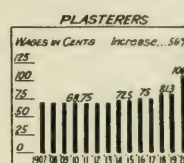
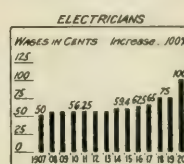
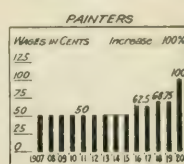
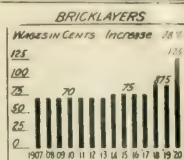


Fig. 4. Hourly Wages of Typical Building Trades in New York City from 1907 to 1920.

Practical Points on the Erection and Care of Chemical Stoneware Apparatus

By Ismar Ginsberg

Aetna Explosives Co.

CHEMICAL stoneware apparatus, particularly in the form of tanks, jars and towers, is capable of supporting great weight. As regards towers, with standard packing used, the internal pressure imparted to the tower structure itself is practically negligible. With such packing as coke, broken ceramic ware, etc., care must be taken that the downward thrust of the weight of the packing is not imparted to the walls of the tower.

Tower Packing

The function of a tower is to bring into intimate contact a liquid and a gas under such conditions as will affect the maximum contact of the circulating bodies. This is effected by providing the maximum surface area of liquid by means of packing over and down which the liquid trickles to meet the ascending gas introduced at the bottom.

A tower is simply a vertical pipe of diameter and height varying with the nature of the chemical reaction involved in the particular manufacturing process. The packing of a given section should be supported on a perforated plate resting upon a lug. The strength of this support permits of its use, as a rule, in every third section to carry the intermediate packing. The weight of the packing, therefore, is borne by the walls of the tower rather than supported by the base.

In practice the use of a perforated support plate is confined to every third section, it being considered that it can carry safely six feet of packing. Scaffolding support is necessary for each section of the tower structure.

Foundations

In erecting a tower it is very essential that the base is plumb with the walls. A simple method of setting up towers which insures that the apparatus shall be vertical consists in building the foundation in the form of a brick or masonry crown into the interior of which cement is poured. The bottom section of the apparatus set in the cement compels the mass to support the interior load without undue pressure upon the bottom alone. Cement may be used for apparatus of any size, which on setting takes the shape of the bottom section and forms a perfect support.

The cascade, or saucer bottom, lends itself well in making a tower foundation of this kind. With a masonry foundation it is well to put on the supporting surface a sheet of asbestos board which, distributing the load more evenly, equalizes the weight of the tower and contents.

Erection of Towers

In the erection of towers of small diameter, it is practicable to place, three and even four sections on top of each other, which is advisable, however, only in the case of empty towers, without supporting the intermediate sections.

On the other hand, in the towers of large diameter, either containing heavy packing or made up of a large number of superimposed sections, it is necessary to provide a suitable and very rigid supporting framework for the intermediate sections. The framework

is built around the section under the flange so that the weight of the apparatus as well as that of the packing and the materials that pass through the tower is carried on this support. The weight should not rest directly on the cross-beams of the framework. Wood wedges should be used, the height of which may be adjusted as required. If this precaution is not taken, there is danger of supporting the flanges improperly, that is, allowing the entire weight of the sections to rest on the lower segments, instead of on the cross-beams.

When setting up a section of a tower, it is always necessary to make certain that the lower edge fits perfectly within the inner circumference of the flange of the preceding section. If this cannot be done because of the irregularity of the earthenware, small stoneware wedges must be used. These are placed at the spots where perfect contact has not been established. This adjustment may be made by means of wood wedges as well as in the erection of a serpentine condenser placed in a cooling tub. As the height of the drain pipe above the base of the supporting frame work can vary in different condenser coils, if that support is not mounted on wedges, there is danger of encountering serious difficulties when replacing a coil and adjusting the drain-pipe.

Joints

Inasmuch as the success of an earthenware installation is often entirely dependant on how well the joints are made and how carefully they are kept in repair, the conditions necessary to making good joints and the precautions to follow in taking care of them are an important consideration.

In the first place, it must be remembered that the material used to make the joint will come in contact with the liquids or vapors that circulate through or are contained in the earthenware apparatus. The surface of the joint should be reduced to a minimum. Furthermore, the material used should not have a destructive action on the stoneware itself, as, for instance, where a plastic substance is used which expands in the flange and causes it to crack. Finally, the joint should be capable of being easily broken without endangering the entire installation.

Each acid problem demands a cement adapted to the kind of acid handled and its condition in transit whether liquid or gaseous, hot or cold, or strong or weak. Tar or pitch is the usual agglutinant for hydrochloric acid, while with nitric and sulphuric acids, silicate of soda is used.

Cements for Chemical Stoneware

Numerous formulae are used in preparing joint cements. In addition to their use in absorbing, concentrating, Gay-Lussac and Glover towers, they are used for lining tanks for mixing and storing acids, for lining bottoms of acid lead chambers and acid-house floors.

The composition of cements of the proprietary type are, of course, secret but possess sufficient virtue for their intended purpose to make them an important

adjunct in heavy chemical manufacture. When in powder form, they require mixing with 38-40° Bé silicate of soda to make a uniform, rather stiff mortar which must be used before it shows signs of setting. About 40 parts by weight of silicate are required for 100 parts of the cement powder.

Acid-proof brick or tile laid up with this cement must be perfectly dry, with joints no thicker than $\frac{1}{8}$ inch. The cement should be allowed to harden at ordinary temperature with free access to the air, which, according to the weather, may require three days to a week.

Cement for Nitric, Hydrochloric, Acetic, etc.,

Acids Apparatus

Such a cement may be made from reduced asbestos fibre, free from acid-soluble substances, by mixing it with 35-37° Bé silicate of soda until a plastic mass is obtained capable of being worked between the fingers. The mass is tamped into the flanges with a wooden spatula, after having first cleaned the surfaces and painted them with the unmixed silicate of soda. It is well to place a roll of loose asbestos in the bottom of the flange before tamping in the cement so as to avoid forcing the latter into the interior of the apparatus.

In all cases where silicate of soda is used the surfaces to be joined should be painted with concentrated sulphuric acid before the application of the silicate cement and the mass allowed to set over night. This procedure repeated at least three times assures a good coating of deposited silica. Care should be taken that the joined surfaces are flush.

Cement Made from Tar Used, e. g., in Hydrochloric Acid Apparatus

Three parts by weight of clay, one part by weight of crushed stoneware are mixed with coal tar to the consistency of a thick mortar. This cement is used hot and is quite resistant to hydrochloric acid. Asphaltum and fibrous asbestos in suitable admixture form a standard joint packing for all acids in setting up bell and spigot lines, towers, and all acid conduits. When bulk is desired, as in making very large joints, inert material, such as barytes or crushed stoneware may be used. A plastic composition, well adapted to withstand the action of nitric or hydrochloric acid vapors as well as that of water, is made by mixing one part each of powdered rosin and sulphur with two parts of powdered silicate material of which powdered stoneware is a type. This cement is used hot.

Plate Flanges

Pipes provided with plate flanges may be joined, after having the surfaces made smooth, by inserting rubber gasket 2-3 m.m. thick cut to fit. The gasket material is resistant to weak nitric or hydrochloric acid.

Where strong nitric acid is used, the joints are made either by means of asbestos board, 2 m.m. thick, soaked in silicate of soda solution and smeared with a little silicate-asbestos cement thinly made, or with an asbestos board cooked in coal tar and used while hot. In either case the surfaces to be joined should be coated with the cement.

When the surfaces are very smooth, thick boards, prepared as above, are entirely unnecessary. On the contrary, it is much better to reduce the thickness as much as possible, so that as small a cut as possible in the piping is exposed to the acid.

In connecting moving parts with stoneware, e. g., in fixing an iron shaft or a stoneware shaft reinforced with an iron-rod core, into the sleeve of a stoneware agitator, melted sulphur may be used. A cement composed of the following ingredients also is recommended: 20 parts finely ground silica, 2 parts litharge and 1 part unslaked lime, to which is added boiled linseed oil to the desired consistency.

Cements for Nitric and Sulphuric Acids

The following composition gives good results in jointing nitric acid apparatus working under vacuum, but only where the acid is cold. It also withstands the action of water:

Crude vaseline	400 parts
Crude paraffin	100 parts
Asbestos fibre	120 parts
Powdered talc	80 parts
Powdered siliceous material.....	300 parts

The vaseline first is reduced to a liquid and the crude paraffin added, with stirring, until fusion is complete. The acid-resistant and body-imparting material, previously mixed, is then incorporated. The cohering agent, i. e., asbestos is added last, slowly and with constant stirring. This composition is applied cold.

Rubber Cements

Compounds of which rubber is an essential ingredient also resist acids and have the advantage of elasticity. They may be made by dissolving reduced rubber clippings, pipe-ends, old valves, etc., in hot, thickened linseed oil. The mixture is cooked until a homogeneous mass is obtained.

When a joint leaks, the practice often is to stop the leak by smearing on some fresh cement. This is a bad practice and results in making the joints bulky. Furthermore, when treated in this way, they rarely give satisfaction. It is much better to cut away about $\frac{1}{2}$ or $\frac{3}{4}$ of the thickness of the joint and fill it up again with newly-made cement.

Joints Between Wood and Earthenware

An example is the pipes of a serpentine condenser passing through a wooden tub. It is essential that the sides of the hole parallel the axis of the outlet pipe. A thick, rubber plug surrounding the earthenware pipe is forced carefully into the annular space from the outside. Two half-rings of wood are cut to fit the remaining empty space between pipe and hole. These rings are set in a plastic composition of tow in white lead. A thin sheet of lead, pierced with a hole to allow the outlet pipe to pass through and nailed to the tube, keeps the plastic in place and wedges it against the walls.

Following upon the announcement of the Proctor & Gamble Co. to build an extensive soap plant on San Francisco Bay and to centralize its oriental oil handling facilities at that port, comes the purchase by the Oriental Vegetable Oil Co., San Francisco, Cal., a subsidiary of W. R. Grace & Co., of Hanover Sq., New York, of the Bullshead Refinery at Martinez, Cal., including a tract of 131 acres. The Oriental Vegetable Oil Co. will expend \$4,000,000 to \$5,000,000 in enlarging the plant, building piers, dredging and the like, so that ships of the Grace line can discharge cargoes direct to the refinery. John H. Rosseter, who was director of operations of the United States Shipping Board during the war, is president of the oil company.

Progress in the By-Product Coke Industry

A Description of the Operation and Results of the Ford By-Product Coke Oven Plant.

By S. R. Bellamy
Semet-Solvay Company

THE year 1919 is memorable in the coke industry of the United States, for then production of by-product coke exceeded that of bee-hive coke. With close to 11,000 by-product coke ovens in present operation, the industry is one of huge dimensions; the modern coking plant is one of the great achievements of chemical and mechanical engineering.* The results of a modern plant show what progress has been made. The high yields indicate improved methods; the uniform yields indicate the extent to which operation is under control. A better knowledge of the factors that are essential for good results, coupled with the ability to control these conditions, is the feature of our best plants. The expansion of the by-product coke oven industry has been marked by three distinct periods, which, with the attributed cause, are given in order of sequence.

I. Recognition by the steel industry that by-product coke could be made that was superior to any bee-hive coke.

II. Recognition by the gas industry of the fact that in the by-product coke oven was its opportunity for development on the lines of real efficiency and economy.

III. General conviction that the market for benzol, ammonia and tar was firmly established and able to absorb all possible production from coke ovens.

The first period was realized by overcoming the old-time prejudice of the blast furnace operator and then seeking his co-operation in determining what constituted a satisfactory metallurgical coke. To illustrate this, the work of the Semet-Solvay Company in conjunction with that of different blast furnaces is most interesting. For years this company made daily all the tests of which it had knowledge, such as sp. gr., porosity, shatter, loss in $C O_2$, size of pieces and structure. These tests, accompanied by investigation and research at ovens and furnaces, finally led to the fixing of certain definite standards. By strict adherence to these standards by-product coke has come to sell at a premium. Factors which are considered essential to the production of high grade furnace coke are:

(1) Proper preparation of the coke in all respects, including size.

(2) Uniformity of the coal mixture used in the manufacture of coke, thereby producing coke of reliable chemical composition.

(3) Uniformity of heating of the charges in the oven, thereby controlling the physical structure of the coke.

Coke Oven Gas

The commercial value of the surplus gas from by-product coke ovens was slow to be appreciated; it was only about eight years ago that any general recognition of this value was apparent. Since then progress in this direction has been so remarkable that today the by-product oven looms up as the real solution to the problems confronting our public gas utilities. Very many of the large cities east of the Mississippi River

are now supplied with coke-oven gas straight or mixed with water gas. The literature of the gas industry as concerns manufacture is now largely devoted to the by-product oven.

In this field again co-operation has meant success. Joint investigation by these two industries has made it possible for the modern by-product plant to deliver a coal gas that will pass the most exacting specifications as to B. T. U.'s, candle power and purity; and this gas can be produced so economically that no other process can compete. Some of the factors that make the production of such high-grade gas possible are: (1) Proper mixture of proper coals; (2) tight ovens; (3) proper regulation of pressure in ovens and in the hydraulic mains; (4) proper carbonization temperatures, and (5) constant and reliable observations.

Market for By-Products

During the world war the by-products from coke ovens were found to be indispensable. Because of their extensive application at that time the merits of these products are now appreciated to the extent that they are just as indispensable in times of peace. As soon as this market was established, the coke and gas industry was quick to avail itself of the fact, and the growth of the industry has been very rapid since then (1914).

The by-products are the same now as before the war, although at that time the Semet-Solvay Company was the only commercial producer of light oils. Improved methods, chiefly in the control of operating conditions, have resulted in much better yields of these products. There is an old coke-oven axiom that temperatures, incident to the so-called high-speed operation, seriously affect the yields. Under modern practice this has been changed so that it can be said that temperatures properly related to the speed of operation do not seriously affect the yields. And likewise the other determining factors are now under regulation.

The Ford By-Product Coke Oven Plant

The modern practices and methods are well exemplified in the plant of the Ford Motor Company at River Rouge, Mich., which is considered by many to be the finest by-product coke oven plant in the world.

This plant was completed and put in operation in October, 1919. Its chief function is to supply a high grade metallurgical coke to the Ford blast furnaces. At the same time a contract with the Detroit City Gas Company calls for 10,000,000 cu. ft. of 18 C. P. and 600 B. T. U.'s gas per day. Thus these ovens constitute a combined coke and gas plant, and must maintain the highest quality in both products. To do this, the speed of operation must not give rise to conflicting factors, but rather all conditions must be properly co-ordinated to the speed of operation. Due to the unsettled conditions in the coal and railroad industries this plant has not had any really fair operation. In fact, very few plants have operated at full capacity during the period under discussion. The operation, however, has been performed at somewhat varying

*Presented at the Canadian Meeting, Montreal, June 28, of the American Institute of Chemical Engineers.

speeds so that a study can be made of the effects, if any, of such changes.

Equipment and Operation

The Ford plant consists of 120 standard Semet-Solvay regenerator coke ovens built in two batteries of equal size, with each battery independent of the other in regard to control of operation. The gas direct from the ovens is received by a double hydraulic main, one main taking the rich gas given off during the first period of carbonization, while the second main receives the remaining lean gas. This separation of gas during carbonization is performed in the usual manner, i. e., by easily operated valves which can be reversed when and as often as desired. The rich gas and lean gas are treated exactly alike up to the benzol scrubbers. Here the treatment is different and after passing through these scrubbers, the two gases travel different paths, the lean returning to the ovens, the rich gas after enrichment and purification going to the city. The apparatus and equipment used to handle the gas is built in triplicate, one unit for the rich gas, one for the lean, with the third and middle unit as a spare. This spare unit is so connected to the system that it can take care of either the rich or lean gas as necessary. The importance of this feature is that repairs, apparatus, cleaning and inspection do not cause inefficient or irregular operation. Having a spare system of by-product recovery apparatus and a spare for all essential machinery used on the ovens, this plant is enabled to operate on a time-table schedule.

Every oven is pushed at the exact time scheduled, the schedule being observed with railroad precision. This regularity of operation which is essential to the production of a satisfactory quality of surplus gas, where high standards are required, means also that the load on the by-product apparatus is uniform and favorable for maximum by-product yields. In the table of results it will be noted that the initial rich gas has been produced without an appreciable variation in B. T. U. value for over three months.

Oven Capacity

Each oven is designed for a charge of 15 tons of pulverized coal and to carbonize this coal in any period from 16 to 30 hours as desired. The capacity of the oven and the uniform coal charges are points that are worth emphasizing. At the Ford plant, not only is the daily average charge per oven uniform, but there is very little variation in the weights of coal charged in the different ovens. The regularity maintained in this operation is shown by Table I, which gives average daily weight of coal charged per shift. This curve is posted in the foreman's office and closely watched by all three shifts.

The size of an oven is determined by the amount of coal that it can carbonize successfully. Size so far has been an index to the progress of the industry, increasing capacity resulting in lower unit costs. This, because the plant, exclusive of ovens and force required for operation and maintenance of complete plant, is fixed and independent of oven capacity. That is to say the power plant, by-product recovery apparatus, piping and other machinery will be practically the same for any given plant regardless of the capacity of its ovens, while the number of workers will be almost the same. The increased tonnage due to large capacity of units will therefore give its yields at little or no cost of production.

Plant Capacity and Yields

Operating on an 18-hour schedule, the Ford plant has a daily capacity of 2,400 tons of coal. Were these ovens of 12-ton size the capacity of the plant on a like schedule would be 1,920 tons. In a 30-day month this would mean that the 15-ton unit plant would carbonize 14,400 more tons of coal than the smaller unit plant. The yields from this increased tonnage would be about 10,000 tons of coke, 345,000 pounds of ammonium sulphate, 45,000 gallons of light oil; 115,000 gallons of tar, and 86,000,000 cu. ft. of surplus gas. Figuring that the value of the coke recovered would cancel the cost of the additional coal and cost of producing by-products, there would be a net gain something like this:

345,000 pounds (NH ₄) ₂ SO ₄ @ 5c. per pound.....	\$17,250
45,000 gallons light oil @ 15c. per gallon.....	6,750
115,000 gallons of tar @ 4c. per gallon.....	4,600
86,000 M. cu. ft. gas @ 20c. per M.....	17,200
Total monthly gain.....	\$45,800

It is true that the initial cost of the larger plant would be greater, but the returns, just enumerated would yield handsome interest on the additional capital required.

Ammonium Sulfate

Ammonia is recovered by the Semet-Solvay direct ammonium sulfate process, which, representing over eight years' extensive experience with direct methods, marks a notable achievement in chemical engineering. The process is direct in procedure, practically automatic in operation and produces a pure white salt. The high yields obtained are explained readily by the direct manner in which the gas is treated and by the control of the ammonia reactions.

In the first place, each oven is properly filled with coal, as previously described, so that favorable conditions exist at the start. The coke-oven gas, upon leaving the ovens, travels a short distance from the hydraulic main and then passes through a two-compartment cooler. From these coolers, an exhaustor (Curtiss steam turbine) takes the gas and sends it under pressure through a tar extractor of the P. & A. type; then through another two-compartment apparatus, called an economizer, from which apparatus it goes to the saturator.

The gas leaves the saturator minus its ammonia, is freed of acid and then cooled for benzol recovery. This is the full journey of the gas so far as ammonia is concerned.

The gas enters the two-compartment cooler at a temperature slightly above 80° C. In the first compartment the temperature is lowered about 30° C. and in the second compartment it is brought down to 30° C. This temperature of 30° C. has been found to be the critical one for proper condensation in conjunction with minimum effort for subsequent heating. The cooling medium is a weak ammonia liquor, which, traveling over grids counter-current to the gas, is very efficient. The strength of this liquor is maintained so that only a minimum amount of NH₃ will be absorbed in the cooling of the gas and the condensation of the light tars. Separation of the tar and liquor is effected in the coolers, which have a large base, by means of decantation. The tar is drawn off from the bottom and runs to a decanter, while the liquor entering the suction pipe of the pump at a higher point, is sent through

cooling coils and then back to the gas cooler. Each compartment of this cooler has its own circulation. A special constant level overflow device maintains a constant volume of liquor for circulation by carrying away an amount equivalent to that added by condensation and absorption of ammonia.

Ammonia thus held in solution has to be liberated by steam and lime in a still, from which it returns to the gas at inlet to saturator. With this exception, the process is "direct."

The Curtiss steam turbine, whose primary function is that of an exhauster, serves in a three-fold manner; for in pumping the gas, it is at the same time, an efficient tar extractor. Due to heat of compression, the gas leaves the turbine at 50° C. or about 20° C. higher than it entered. Thus the turbine is exhauster, tar extractor and heater combined. The P. & A. tar extractor removes the last trace of tar.

From the tar extractor the gas goes to the economizer, where it is brought in contact with the liquor of condensation from the hydraulic main, to pick up and restore to the gas some of the water of condensation and free ammonia; the gas leaving the economizer is at the proper temperature for the sulfate reaction.

The clean gas at 70° C. enters the saturator, which contains sulfuric acid of 45 g.p.l. strength, i. e., nearly normal acid. The saturated acid is lifted by means of an air ejector into a sludge tank in which crystallization takes place and the unsaturated acid drains back to the saturator. The salt goes to a centrifugal where it is first dried and then washed with water. It is dumped from the centrifugals into barrows, weighed and conveyed to a large hopper from which it is handled into storage by an overhead crane.

A small stream of fresh acid (60° Baume) flowing into the saturator keeps the strength at the proper mark. With acid of the proper strength and gas at the proper temperature, objectionable crystal formation does not take place in the saturator. The small amount of crystals that are bound to form on metal surfaces are not permitted to accumulate. Once each day for a few minutes the acid strength is built up 125 g.p.l. and thus all crystals are dissolved and a clean saturator maintained.

Results

The results obtained at the Ford plant are indicative of the progress that this process makes in ammonia recovery. The high yields, as shown in the tables of operation data, were obtained from a coal mixture containing 20 per cent. low volatile coal. From straight high volatile coal, even higher yields may be expected.

As important as the yield of a by-product, is the cost of production. The unit cost is the test that tells the tale. During the month of April this plant produced over 1,500,000 pounds of ammonium sulfate with an operating force of five men per eight-hour shift and one foreman. This foreman also has charge of the light oil plant.

Clean Gas

One of the most essential points in a direct ammonium sulfate process is clean gas. Practically all the treatment through which the gas passes, preparatory for entrance to the saturators, is made with the one purpose of obtaining clean gas. Upon the success of this treatment the purity and color of the sulfate depends. Hence, the vital question is, "How clean

is the gas?" To determine this, the filter paper method devised by the Semet-Solvay Company has been found very valuable. By means of an apparatus, called the Tar Camera, a known volume of gas can be drawn through filter paper and a comparison made of the color produced on the filter paper to indicate the degree of purification of the gas. As usually performed, two filter papers are used for each test to absorb the tar from 8 liters of gas.

The amount of tar carried by the gas should be reported by comparing these filter papers with a photographic scale, similar to that used in any color comparison quantitative test; or where great accuracy is required the determination is made by weighing the filter papers before and after the picture. This apparatus can also be used for the determination of H₂S in gas. In this test the filter papers used are of course, moistened with lead acetate.

TABLE I.—FORD OPERATING DATA, 1920.
ACTUAL RESULTS OF SEMET-SOLVAY
DIRECT AMMONIUM SULFATE PROCESS.

Date	Per Coal Charged, Tons Per Day	Coal Moisture, Per Cent.	Sulfate Consumed, Lbs. Per Ton	% N ₂ Sulfate	Acid Consumed Per Lb.	(NH ₄) ₂ SO ₄ % Free Acid in Sulfate	% Moisture Sulfate
Jan.	1813	5.2	25.7	25.01	1.07	.169	2.25
Feb.	1813	4.4	26.5	24.94	1.01	.135	2.42
Mar.	2030	4.0	25.9	25.00	.95	.125	2.46
April ...	2022	3.5	25.8	24.99	1.00	.112	2.16
May	1911	3.5	26.8	25.00	1.02	.151	1.84

Surplus Gas and Modern Calorimetric Standard

The method employed for the preparation for sale of the surplus gas from the coke-oven plant is determined by the specifications which the gas has to meet. The general trend in the industry is toward the elimination of candle-power specifications and the lowering of the calorific value of the gas required for cities. Canada has now permanently adopted a standard of 450 B. T. U.'s. and no candle power. Only three of the larger cities of the United States still cling to a high candle-power specification.

This development is in direct line with the conservation of the natural resources of the country, which has its real beginning in the efficient utilization of our basic fuel. It is to the economic advantage of both producer and consumer of gas. It is no longer good economy to enrich gas with benzol to produce candle power when the requirements for motor fuel are rapidly outstripping the supply. Money spent for enrichment of gas is practically all wasted, as, with very few exceptions, the consumer derives no benefit therefrom. The purchase of special coals, or the separation of the rich gas from the lean, or any other operation involving cost, to increase the calorific value of manufactured gas, brings no benefit to the consumer who must, of course, pay for this increased cost. Public Service Commissions and gas manufacturers should join in the determination and adoption of the standard of calorific value which permits a million B. T. U. to be delivered to the consumer at the lowest price. Of course, gases containing high percentages of nitrogen, like producer gas, are not considered in this discussion. This argument is illustrated by the following table, which shows the B. T. U. per cubic foot in the various gases when mixed with the theoretical

amount of air required for their combustion. This mixture of gas and air is what the consumer actually burns, so it is clear that any of these gases, when properly burned with the correct percentage of air, will give the same results.

	Natural Gas	Oil Gas	Retort Gas	Coke-Oven Gas	Gas from Water	Gas from Water
B. T. U.	91	93	91.7	91	92	88
Temp. (Flame) ..	1852	1915	1896	1892	1914	1928

So the real point of interest to the consumer is which gas can be furnished to him at the lowest cost per million B. T. U. In several cities, however, the legal standards still require the delivery of gas of high candle power and high B. T. U. content, and the gas from the Ford plant has to meet the standard of 18 candles and 600 B. T. U.

Light Oil and Gas Enrichment

The recovery of light oil at the Ford plant is so closely related to the enrichment of gas that these two

Separation of Naphthalene Procedure

The lean gas, upon leaving the saturator, is cooled and enters the benzol scrubber at a temperature of about 25° C. In this tall tower it is completely stripped of its light oil content by being washed with an absorption oil of like temperature. This absorption oil, straw oil or ordinary gas oil, is circulated counter-current to the gas flow and leaves the scrubber containing about 2 per cent. of light oil.

The rich gas upon leaving the saturator is likewise cooled and enters a benzol scrubber at the desired temperature. Here it is washed by one-half of the benzolized absorption oil from the lean scrubber, the other half of this oil going directly to the light oil still. The small circulation of benzolized oil absorbs all the naphthalene from the gas, also some toluol and xylol, but removes very little benzol. Thus the gas is purified of naphthalene without serious loss of other illuminants. The drop in B. T. U. and candle power, due to this treatment, is so slight that very little enrichment is necessary. According

TABLE II. FORD OPERATING DATA 1920. SURPLUS GAS, LIGHT OIL AND TAR YIELDS.

Date	Dry Coal Charged Tons per Day	Total Gas Per Ton of Coal M. Cu. Ft.	Gas to City per Day M. Cu. Ft.	Candle Power Initial Rich Gas	Candle Power Gas to City Official	Light Consumed for Enrich Gals. per M. Cu. Ft.	BTU Gas to City	Light Oil Produced Gals. per Ton	True L. O. Yield Gals. per Ton	Far Yield Gals. per Ton
January	1813	10.53	9959	12.83	18.08	.33	636	2.32	2.65	6.02
February	1813	10.39	10135	13.82	18.17	.14	647	2.35	3.74	8.09
March	2030	10.63	10004	14.05	18.14	.10	648	2.61	3.76	8.84
April	2022	10.50	9906	14.27	18.21	.10	638	2.43	3.68	8.64
May	1911	10.04	10518	15.21	18.12	.05	643	2.42	3.45	8.51

subjects can well be treated together. As is usual in plants where surplus gas of high calorific and candle power specifications is sold to public utilities, the rich and lean gases follow parallel, but separate, paths throughout the by-product recovery system. Up to the benzol scrubbers they are treated exactly alike, but from here on the treatment differs.

It is a comparatively simple matter to obtain large yields of surplus gas that will pass the average B. T. U. requirements, which have recently been lowered in most states. In such cases it is possible to remove practically all the light oils from the gas and if so, the rich and lean gases can be treated alike in the recovery of benzol, or the gases may be treated without separation, if the calorific standard permits. In being freed of its light oil, the surplus gas is lowered in B. T. U. value, but at the same time it has all of its naphthalene removed. This treatment gives a gas suitable for distribution and, if separated, of 590 to 600 B. T. U. value. Such a gas meets the requirements of many cities which retain a high calorific standard, but it will not pass a high candle power specification; and where such exists it is necessary to produce a very high grade gas. Proper oven operation will yield such a gas, after which this quality must be maintained and delivered to the city without loss. For distribution it is essential that this gas be free of naphthalene but it can not stand the loss of any other illuminant. Of course, all the light oils could be washed out, freed of naphthalene and then used to enrich the gas to the proper mark. A high grade gas would result, but the process would be rather inefficient and very expensive. The correct way is to take out the naphthalene without removing the light oils. This is accomplished at the Ford plant by the standard Semet-Solvay apparatus and methods.

to the latest figures, only .07 gal. of light oil is vaporized per 1000 cu. ft. of gas to bring the gas above specifications.

Uniformity of Results

The most important feature of this surplus gas operation is the uniformity of results. Not only has the surplus gas yield been high, as will be noted from table of operating data, but it has been a yield of high grade gas. That is the important fact, for the yield of surplus gas means nothing independently of quality. Furthermore this yield has been almost constant in amount through the varying speeds of operation. Every day from January 1st to June 1st, the Gas Company has received practically 10,000,000 cu. ft. of gas from these ovens, invariably above the standard and with scarcely any variation in B. T. U. or candle power values. The uniformity of these results appear remarkable in comparison to those obtained only a few years ago, but show what can be expected from modern ovens with advanced knowledge and methods of regulation. The maximum gas recovery here shown is one reason also for the uniformly high sulfate yield.

The light oil still is of the standard Semet-Solvay type. No fractionation is made, but the light oil is purified, washed and redistilled and sold as motor fuel. A satisfactory motor fuel consisting of benzol, toluol, and xylol, mixed with an equal amount of gasoline, gave the following distillation results:

B. P.	71° C		
Sp. Gr. @ 16° C.	.811		
Off at 85° C	10%	Off at 130° C	70%
88	20%	154	80%
91	30%	195	90%
96	40%	218	95%
103	50%	Loss on Dist.	2%
114	60%	Residue	3%

During the switchmen's strike there was a gasoline shortage in Detroit which caused some worry but little or no inconvenience, due to the fact that the Ford plant was able to release 300,000 gallons of purified light oil for motor fuel. Tank wagons from the various companies came to the plant for oil and then distributed it throughout the city. Thus a serious situation was averted.

The light oil that is recovered by the method described, comes mainly from the lean gas. The true yield is therefore the sum of the oil produced and the oil left in the rich gas. This total would mean a high commercial yield and one that would be possible wherever the gas specification was below 600 B. T. U. with no candle power requirements.

Disposition of the Tar

With the enormously increased supplies of tar the market has kept pace and today tar is selling at a decidedly higher price, but yet somewhat below its true value. Tar lends itself readily to a variety of uses, many of which are just beginning to be appreciated. The Ford experience affords an interesting illustration in this respect.

The original boiler equipment contained eight 400 H. P. Wickes boilers arranged for gas firing. The demand for gas was so heavy that tar was utilized in its place most satisfactorily and at a decided saving over coal, the value of tar being taken at 5c. per

gallon. When using tar, the pump at the storage tank is run continuously so that there is a constant circulation sufficient to meet the highest peaks and yet allow excess tar to be by-passed from the discharge to the suction line. In order to keep the tar hot, the discharge line is wrapped with two 2-in. steam lines and the tar reaches the boilers at a temperature of 90° C. At that point, superheated steam is used to raise the temperature to 100° C. and by means of steam injectors delivered to the tar burners.

When the price of fuel oil became almost prohibitory, the Ford Company began experimenting with tar to take the place of oil in the heat treatment of forgings, etc. This worked out so satisfactorily that they expect shortly to be using 15,000 gallons of tar per day, which will do the same amount of work as the 25,000 gallons of fuel oil formerly used. Part of this is due to the higher efficiency of the tar and the balance to improvements in operation. This tar is as it comes from the by-product coke plant, no further refinements being necessary.

In conclusion, I wish to acknowledge the assistance given by Mr. A. A. Kelkenney, superintendent of the Ford coke plant, in preparing the operating data shown here and to express my appreciation of the courtesies and assistance given me by his organization.

Liquid Chlorine and Its Use in Water Purification

In a 20-page, 6x9 booklet, having as a cover design a view of Niagara Falls, the Electro Bleaching Gas Co., 18 East 41st street, New York, has reprinted an article by John A. Kienle, contributed to the *Journal of the American Water Works Association*, on "The Relation of the Chemical Industry of Niagara Falls to the Water Works."

Mr. Kienle has described the manufacture of chlorine and bleaching powder and discussed their use in American water works practice. Excellent photographs of the interior of a bleaching powder chamber, an electrolytic cell house and chlorine-compression equipment, together with a diagram of a compression plant, are used to illustrate the text. Copy of the book will be sent on request.

Dr. E. E. Lungwitz, chemical and metallurgical engineer, 90 West street, New York City, who is well known among chemical manufacturers on account of his introducing the Kelly Filter Press in chemical works, is on a business and pleasure trip in Europe. Dr. Lungwitz is taking a much needed rest, and is visiting relatives and some of the haunts of his boyhood days.

Prof. John Johnston, of Yale University, has been elected member, and Dr. Frederick G. Cottrell, of the Bureau of Mines, the chairman of the executive committee of the Chemical Division of the National Research Council.

* * *

Dicks, David Co., Inc., manufacturers and dealers in dyestuffs, 19-21 North Moore St., New York City, has purchased adjacent properties, Nos. 17 and 23. It is planned to erect a modern structure on the entire property.

Eastman Kodak Co.

George Eastman, president of the Eastman Kodak Company, has supplemented his past donations of \$3,500,000 to the School of Music of the University of Rochester, by a gift of \$1,000,000. Mr. Eastman also has given \$4,000,000 and a dental dispensary that he had established in Rochester toward the founding of a School of Medicine and Surgery at the university.

Profits of the Eastman Kodak Company of New Jersey, and subsidiary companies in 1919 were \$18,326,188.31. Of this amount \$7,819,110 was distributed to common stockholders and \$369,942 to preferred stockholders.

The company surplus was increased by \$10,137,136, making the present total \$42,008,907. One item of the company's current liabilities, listed in the report, is a reserve of \$6,089,692.99 for war excess profits and income taxes.

* * *

Louis W. Mahle, formerly at the Frankford, Pa., plant of the Barrett Co., is now chemical engineer with the Ohio Boxboard Co., Rittman, Ohio.

* * *

Howard D. Corkum is now with the du Pont dyestuffs sales department. He was superintendent of the worsted department of the Sayles Bleacheries, at Saylesville, R. I.

* * *

W. H. Matthews is plant superintendent of the Liberty Yeast Corp., Cambridge, Mass.

* * *

Dr. Lauder W. Jones, until recently dean of the Chemical and Engineering Schools of the University of Minnesota, and one of the most eminent chemists in the United States, has been called to Princeton to fill the newly endowed A. Barton Hepburn Chair of Organic Chemistry. He will take up his work in September.

Personal Items

Edgar S. Genstein is now metallurgist for the Treadwell Engineering Co, Easton, Pa., having resigned his former connection as engineer of tests of the U. S. Naval Ordnance plant, South Charleston, W. Va.

* * *

F. B. Winslow, chemist, Millbury Steel Foundry Co., Millbury, Mass., has been made superintendent to succeed O. K. Carpenter, resigned.

* * *

Grandon D. Gates, assistant works superintendent of the Celluloid Co., Newark, N. J., has recently resigned to become associated with the Davis-Watkins Dairymen's Mfg. Co., as general manager of its Derby, Conn., plant.

* * *

J. P. Begley has been made chief chemist of the American Steel Foundries, with headquarters at St. Louis. He will have charge of all the laboratories. He was formerly identified with the Davis wheel department of the same company.

* * *

Otto C. Stanger, formerly in charge of the toilet specialties department of the Armour Soap Works, Chicago, is now engaged in industrial research work with the Miner Laboratories of that city.

* * *

D. O. Jones, formerly in charge of the laboratory of the Armour Fertilizer Works, Chicago, is now with the Newport Chemical Works, Carrollville, Wis.

* * *

R. M. Carpenter, vice-president of the E. I. du Pont de Nemours Company, has recently announced that his company has made such progress in the manufacture of synthetic camphor that they are "practically out of the woods," and that this will be of great advantage to all manufacturers of celluloid or similar products.

* * *

A. M. Muckenfuss, formerly director of the department of organic and industrial chemistry at Emory University, Atlanta, Ga., is now engaged in research work with the Roessler & Hasslacher Chemical Co., Perth Amboy, N. J.

* * *

Robert V. Townsend has severed his connection with the Semet-Solvay Co., Syracuse, N. Y., where he was in charge of chlorinated toluene products manufacture, to organize and direct the chemical research department of the Victor Talking Machine Co., Camden, N. J.

* * *

W. N. Pritchard, Jr., formerly pulp mill superintendent at the Augusta, Ga., plant of the Procter & Gamble Distributing Co., is now engaged in dye research work with the Calco Chemical Co., Bound Brook, N. J.

* * *

H. S. Grigsby, formerly in charge of the inspection laboratory of the provision and clothing department of the Navy, is now research chemist at the Bronx plant of the Ward Baking Co., New York City.

* * *

C. H. McClure has resigned his position as chief chemist of the Commonwealth Edison Co. to accept the position of chemist with the Menasha Printing & Carton Co., Menasha, Wis.

George K. Senior, soap chemist, has transferred his connection from the American Textile Soap Co., Springfield, Mass., to the Warren Soap Co., Boston, Mass.

* * *

Frank E. Glassman, formerly with the Specials Chemical Co., Highland Park, Ill., has organized the Vulcan Chemical Co., Chicago, to manufacture soldering compounds.

* * *

Prof. Alfred H. White, head of the department of chemical engineering, University of Michigan, has sailed for France, where he will investigate the nitrogen situation.

* * *

Mr. F. Schlager, formerly with the Grasselli Chemical Co., is now in charge of the dyestuff department of the Marsden-Sewell Corporation, 115 Broadway, New York.

* * *

A. L. Jamison, formerly with the Berlin Aniline Works, Phila.; E. S. Millsbaugh, formerly with the Atlantic Dyestuffs Co., Burrage, Mass., and O. B. Hess, formerly with the Castle Kid Leather Co., Camden, N. J., are recent additions to the sales staff of the Philadelphia office, 38 North Front street, of Aniline Dyes & Chemicals, Inc., of 134 Cedar street, New York.

* * *

Earl Stafford recently has become a member of the engineering staff of Arthur D. Little, Inc., chemists and engineers, Cambridge, Mass. Mr. Stafford is a graduate of the engineering school of Tufts College, 1908, and for the past twelve years has devoted his attention largely to hydro-electric developments with particular reference to ore-treating plants, pulp and paper mills and light and power companies.

* * *

A. H. O'Gorman, formerly connected with Johnson & Johnson, New Brunswick, N. J., is now associated with the Takamine Laboratory, Inc., New York.

* * *

Henry H. Mayers, formerly with E. I. du Pont de Nemours & Co., Paulsboro, N. J., where he was supervisor of the strontium nitrate department, is now in the research department of Rohm & Haas Co., Bristol, Pa.

* * *

Prof. Hector James Hughes has been made dean of the Harvard University Engineering School, Cambridge, Mass., to succeed Comfort Avery Adams, who recently resigned to become chairman of the National Research Council.

* * *

The assumption of the business interests of Bosson & Lane, Atlantic, Mass., by E. P. Bosson, marks the retirement of N. H. Lane from active work in a field in which he was a pioneer. Mr. Lane was the first man in the United States to manufacture turkey red oil—alizarine assistant—on a commercial scale.

In 1876 he had served the Walpole Dye & Chemical Co. as superintendent for four years, and for 15 years acted in a like capacity for Johnson & Shaw. For more than 25 years he has been associated with Mr. Bosson, who will continue the business.

* * *

Fred West, chief of the U. S. Customs Laboratory of the Port of New York, has recently resigned to accept the position of chief chemist of the United Drug Company at its new St. Louis plant.

Industrial Notes

The Seaboard Refractories Co., Valentine, near Fords, N. J., has been organized to manufacture high-grade refractories. The officials of the company are those formerly interested in the Didier-March Co., Keasbey, N. J., manufacturer of tunnel kilns, etc., including George A. Balz, Millard E. Gray and Carl Von Hartz. The Didier-March plant was recently acquired by the Carborundum Co., Niagara Falls, N. Y., and arrangements have been made for early operation.

* * *

The Wildman Rubber Co., 817 Book Building, Detroit, is planning for the immediate erection of the first unit of its new tire plant at Bay City, Mich., estimated to cost about \$1,000,000, including equipment. Two additional units will be erected later, bringing the total cost in excess of \$2,100,000. The company has a 60-acre site along the Saginaw River. The Osborne Engineering Co., Cleveland, is engineer. W. W. Wildman is president.

* * *

The Kentucky Refractories Corporation, Russell, Ky., recently incorporated with a capital stock of \$750,000, has plans under way for three manufacturing units for the production of high-grade refractories with a daily capacity of about 50,000 firebrick per unit. The company has taken over about 2,500 acres of clay properties in that section. Clyde K. Turley is manager.

* * *

The Mutual Enamel Ware Co., Chattanooga, Tenn., has been organized by officials of the Cahill Iron Works, to manufacture heavy enamel ware products. An addition will be erected to the present Cahill plant, for occupancy by the new organization, estimated to cost about \$250,000, including equipment. F. H. Caldwell is president.

* * *

The United States Industrial Alcohol Co., 27 William Street, New York, has acquired land at the corner of Grand Street and Garrison Avenue, Maspeth, L. I., aggregating about 200,000 sq. ft., for the erection of a new plant, estimated to cost with machinery, close to \$1,000,000.

* * *

The Getszler Storage Battery Co., Highland Park, Ill., has been incorporated in Delaware with capital stock of \$300,000 by Henry F. Tenney, Charles F. Harding, Jr., and Harry A. Parkin, Highland Park, to manufacture electric storage batteries.

* * *

The Bird-Archer Co., New York, recently incorporated, has taken over the ammunition plant at Cobourg, Ont., formerly operated by the Cohoes Steel Co., and is transferring its boiler chemical department to the new plant.

* * *

The Alabama Silica Products Co., Trussville, Ala., will install new stone grinding machinery, conveyors, loading apparatus, etc., in connection with extensions to its recently acquired works in this section. E. D. Jordan is president and manager.

* * *

The Presto-Lite Co., 30 East Forty-second Street, New York, manufacturer of acetylene apparatus, has taken bids for its proposed new plant at Baltimore, to consist of eight one-story brick and steel buildings, each about 25 x 50 ft., to cost \$75,000.

The Southern Cotton Oil Co., 120 Broadway, N. Y., has secured at Hopewell, Va., from the Du Pont Chemical Co., 100 acres of land with buildings as a plant site for its project to manufacture paper pulp from cotton linters. The Stamscott Company will be organized to build and operate the permanent plant and to arrange for additional factories in other parts of the South. Besides the Southern Cotton Oil Company, the American Cotton Oil Company and the East St. Louis Cotton Oil Company are interested, with Stewart Seamon representing them at Hopewell.

* * *

Lewis & Marks, Vereeniging, Transvaal, South Africa, have under construction at that place a starch and glucose plant costing \$500,000, into which much American equipment will go. The plant, which is in connection with milling interest of Lewis & Marks, will have a daily output of 50,000 pounds of glucose and 55,000 pounds of miscellaneous starch products, and will be managed by American engineers.

* * *

The Standard Turpentine & Rosin Company, with headquarters in Jersey City, has been incorporated under the laws of New Jersey to manufacture and refine oils and other products obtained from wood. The capitalization is \$1,000,000. John R. Turner, Chas. J. Skinner and Alfred McCabe are the incorporators.

* * *

The new two-story machine shop, now in course of erection by the Sowers Mfg. Co., 1300 Niagara Street, Buffalo, manufacturer of chemical equipment, will provide facilities for about 80 men. It will be of reinforced concrete, 60 x 72 ft., serving as an addition to an existing machine shop.

* * *

The Abbott Laboratories, Chicago, will build near Waukegan, Ill., a plant for the manufacture of fine chemicals. Chemical Foundation licenses have been procured for the manufacture of several pharmaceuticals heretofore made in Germany.

* * *

The Stauffer Chemical Co., with plants at Chauncey, N. Y., and San Francisco, Calif., is building at Stege, Calif., a \$1,000,000 sulphuric acid plant with a daily capacity of 40 tons of concentrated acid.

* * *

The Wyoming Chemical Products Co., Duluth, Minn., is building a plant at Shoshoni, Wyo., to recover alum and epsom salts from natural deposits near that place.

* * *

F. B. Hansell, J. Vernon Pimm and E. M. MacFarland, of Philadelphia, have procured a Delaware charter for the American Chemical Products Company, the capital being given as \$5,000,000.

* * *

Southern Carbon Co., Fairbanks, La., will establish three additional carbon black factories, and expend \$1,000,000 in field developments.

* * *

The Koppers Seaboard Coke Co., Jersey City, N. J., has acquired property on the Gowanus Canal, Brooklyn, to be used as a site for works in this district.

* * *

Linde Air Products Co., 30 E. 42d street, New York, will build a \$250,000 oxygen plant at New Orleans, La.

The Banner Chemical Company, Denver, Colorado, has resumed business under its own name separating its business from that of the Clarke Chemical Company, with whom it was consolidated one year ago.

* * *

The Glidden Co. has purchased the Chemical Pigments Corporation with lithophone plant at St. Helena, a Baltimore, Md., suburb, for a consideration reported to be \$500,000.

* * *

* The Blanke-Baer Chemical Co., of St. Louis, Mo., will erect a \$150,000 plant on a recently acquired site in that city. Dr. Samuel H. Baer is vice-president and treasurer.

* * *

The American Linseed Co. has bought the 8-story building on the southeast corner of Madison avenue and 34th street, New York, where it will assemble the various offices of the company now scattered in New York City.

* * *

The Essex Aniline Works, Boston, Mass., has made the Grasselli Chemical Co. sales agents for the distribution of its color products.

* * *

The F. J. Stokes Machine Co., manufacturers of pharmaceutical machinery, chemical apparatus and vacuum dryers, have acquired five acres of land near Cedar Grove, Pa., where the John N. Gill Co. are now constructing a factory, which will be used as a machine shop and erection shop for vacuum dryers and chemical machinery.

* * *

Under the encouragement of protective duties, capacity production of the Canadian branch of the Solvay Process Co., at Amhurstburg, Ontario, has warranted enlargement, plans for which are now under way.

* * *

The Honolulu Iron Works Company, one of the largest sugar machinery companies in the world, has purchased land in Manila for the erection of a machine and machine tool factory.

* * *

Patton Paint Co., Milwaukee, Wis., will build a 2-story, 70x100 varnish plant, and a 60x112 warehouse at their manufacturing headquarters on Lake St., Milwaukee.

* * *

The Sunlight Soap Co., Toronto, Canada, subsidiary Lever Bros., Ltd., will erect a 3-story soap factory costing \$350,000.

* * *

Rules and regulations for the leasing of phosphate lands under the Land Leasing Act have been approved by the Secretary of the Interior and about 2,500,000 acres of such lands in Wyoming, Idaho, Utah and Montana are now subject to lease.

* * *

Blair, Campbell & McLean, Inc., have changed their name to American Chemical & Sugar Machinery Co., the address continuing at Colonial Trust Bldg., Phila., Pa. This change is the result of an agreement between Blair, Campbell & McLean, Ltd., Glasgow, Scotland, and Blair, Campbell & McLean, Inc., Phila. The officers and directors remain the same and the entire policy remains unchanged. In addition to manufacturing its own products, the new company continues

as the sole representative of Blair, Campbell & McLean, Ltd., in the United States and Canada.

* * *

The Standard Powder Co., Phila., Pa., has acquired a 700-acre tract at Horrell, Pa., and will erect structures and equipment for the manufacture of powder.

* * *

The General Chemical Co. has contracted with the J. G. White Engineering Corp. for the erection of a considerable addition to its plant in Cleveland, and has filed plans calling for the erection of the new units. A large part of the new space will be used for the manufacture of sulphate of alumina.

* * *

The naval stores plants of the Yaryan Rosin and Turpentine Co. at Brunswick, Ga. (daily capacity, 540 tons of stump wood), and at Gulfport, Miss. (daily capacity, 180 tons), are administered by the Hercules Powder Co. under an operating contract of one year's duration, with option to purchase at \$2,000,000.

* * *

A salt deposit estimated to contain over 500,000,000 tons of salt has been discovered at Malagash, Cumberland Co., Nova Scotia.

* * *

The National Milling Company of Macon, Ga., will add a peanut mill to its present plant between now and October 1. The mill will have a daily capacity of sixty tons of peanuts. Every part of the peanut plant will be used.

The producers will market their crops as a whole, with the peanuts on the vines. Machinery will separate the nuts from the plants and bale the stalks and leaves as hay. Even the shells will be conserved and ground into meal to be used in feeds. The best quality peanuts will be sold to confectioners and the smaller will be used in making peanut oil and meal.

* * *

James H. Cocke, chief engineer of the Kentucky Distilleries and Warehouse Co., Louisville, Ky., announces that five of the largest Louisville distilleries will be remodeled and utilized for the manufacture of industrial alcohol.

The distilleries to be reopened are the Melwood, Elk Run, Nelson, Anderson and Roach plants at East Louisville. The Elk Run Distillery alone requires no change.

Work on the distilleries is expected to begin within the next three months. It is expected that the plants will be in operation by January 1, 1921. It is planned to ship their product almost entirely by water, using the Ohio River.

The five distillery properties passed into the hands of the United States Food Products Corporation two years ago, but have not been operated since last July.

* * *

The Independent Food Products Corporation, capital \$2,000,000, has been organized at Terre Haute, Ind., to absorb the C. W. Jean Co., with plants in Terre Haute, Worthington and Huntingburg, Ind., capitalized at \$650,000 and engaged in handling poultry, eggs, milk and butter, and the property of the Elgin Brewing Co., Elgin, Ill. Immediate provision will be made for the manufacture of powdered malt sugar and powdered whole milk. The brewery property will have a daily capacity of 75 tons of malt sugar. An additional sugar plant will be erected at Terre Haute.

Lamie Chemical Co. will erect plant additions to its Huntington, West Va., plant, costing \$20,000, to provide additional facilities for lead peroxide and color products.

* * *

The General Lead Batteries Co., Newark, N. J., manufacturer of Titan storage batteries, has recently purchased from the New Jersey Zinc Co. five acres adjoining its present plant at Chapel street and Lister avenue, having a deep water frontage of 250 feet on the Passaic river and 411 feet on Chapel street, together with railroad trackage connecting with the Central Railroad of New Jersey. This tract will at once be improved with a series of reinforced concrete buildings having an area of 300,000 square feet, plans for which have been prepared by Timmis & Chapman. 315 Fifth avenue, New York. This added space will enable the company to extend its sphere of activity in the manufacture of storage batteries. The company has also purchased a two and three-story brick factory having an area of 65,000 square feet at Eightieth street and Belt Line Railroad, Chicago, which will be used for manufacturing and storage purposes.

* * *

The Public Service Commission, 1st district, New York, has granted permission to the Brooklyn Borough Gas Co. to change its gas from 22 candle power, light standard, to 525 B. t. u., heat standard. This is the first change allowed in New York City from the light to the heat standard, which is used widely throughout the United States.

It is estimated that about 25 per cent. can be saved in oil by the change of standard to the heat unit from the illuminating unit. The Commission has been advised by its chief gas engineer, William Merrifield, that 95 per cent. of the company's customers will get just as good service from 525 B. t. u. gas as they do from 22 candle power gas. The other 5 per cent., who use open flame gas burners for illuminating, will have to burn more to get the same illumination or change to mantle lamp burners, which will enable them to get the same illumination from less gas.

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Marathon Paper Mills Company

Some Problems of the Pulp and Paper Industry—A Study of the Service of the Forest Products Laboratory and Its Value to the Pulp and Paper and Allied Industries

By D. C. Everest

Secretary and General Manager, Marathon Paper Mills Company

IN presenting some of the problems of the pulp and paper industry, I intend to deal only with those which relate to the work of the Forest Products Laboratory and which we, as manufacturers, expect to be able to solve by intelligent co-operation with this institution.

Had we, as manufacturers of forest materials awakened to the value of the laboratory to us and taken the interest in it which now apparently is manifested,* there would be fewer problems of our various industries today. The laboratory has been prevented from rendering greater service only by reason of the failure of manufacturers to acquaint the laboratory personnel with the problems confronting them. For ten years the men here have tackled every problem which has been put up to them and have rendered invaluable service to those who have realized the necessity of such work and have made use of the laboratory in the manner intended when this institution was established.

Present Conditions in the Industry Demand the Fulllest Utilization of the Laboratory Resources and the Expansion of Private Research

The present abnormal situation in the paper industry has directed the attention of more manufacturers to the need of immediate and definite action in attacking the various problems with which they are confronted. The attitude in the past has been to take advantage of the improvements only as they have been made by a few progressive manufacturers and a ten-



D. C. EVEREST

General Manager and Secretary, Marathon Paper Mills Company.

dency to procrastinate even in this has been rather common.

The immediate future condition of the industry demands that these problems be attacked in such a manner as to produce definite results in the shortest time; for with the growing scarcity of pulp wood in the eastern and central states and our increasing dependence upon Canada for the supply of raw material, a situation has been created which rightfully can be viewed with alarm. While some research either in a haphazard manner or following a carefully co-ordinated plan has been carried on by the paper industry, it is safe to say that only those organizations in which the program of research was definite, have succeeded in placing the manufacture of their products upon a sound basis and are now able to take full advantage of their foresight.

When research is mentioned among paper mill men and other timber users, too often the audience is unsympathetic if not hostile, and the tendency of many mill operators has been to look with disfavor upon the efforts of investigators along scientific rather than the immediate practical lines.

Despite this attitude, the pulp and paper section of the laboratory has been striving for the past ten years with inadequate funds and personnel to solve some of the pressing problems of the industry. The field is a large one, and most of the work pioneer in character. How successful they have been in their work may be judged from the following recital of the major problems which they have attacked and are now studying.

Pulp Wood Purchase Specifications

The need for definite specifications to cover the pur-

* An address delivered at the decennial celebration of the establishment of the Forest Products Laboratory, Madison, Wisconsin, July 22-23.

chase of pulp wood has long been recognized. That the present basis of purchase, using the cord as the unit of measurement is inaccurate cannot be doubted. As the ordinary piled cord, 4 x 4 x 8, may, depending on the diameter of the bolts, freedom from knots, etc., contain by actual measurement from 104 to 65 cu. ft. of solid wood. Further, the present method of buying wood does not make a proper allowance for the percentage of decay. More than four years ago an attempt was made to interest pulp mills in this problem, but until very recently nothing has been accomplished. However, field work financed by the American Pulp and Paper Association is now under way and no doubt exists but that the results accomplished will meet expectations.

Treatment of Pulp Wood Prior to Receipt at Mill

Closely connected with this problem and of more vital importance, due to the growing scarcity of pulp woods, is that of robbing, chipping, drying and baling of pulp wood preparatory to delivery to the pulp mill. With the vast pulp wood forests of the West practically untouched, it is felt that some such method as this may offer a solution to the decreasing supply of pulp wood in the East. This is now a cost of transportation problem.

Lumber Mill Utilization of Waste

For many years the enormous amounts of the unavoidable waste in the lumber industry has challenged attention. Few pulp mills, however, have been in a position to utilize this waste, and have depended upon round wood for their supply. Conservation of timber resources in time will compel the utmost utilization of this waste. The time is not far distant when lumber mills undoubtedly will undertake the barking of edgings and slabs, chipping and screening the wood and selling, in the case of hemlock, the bark to the tanneries.

Hemlock Bark from the Barking Drums

The utilization of hemlock bark obtained from the barking drums has already been the subject of study upon semi-commercial scale, and it only remains to bring the tanner and pulp man to a mutual understanding of each other's problems. The burning of such bark is indeed a great waste if the value for tanning purposes as shown by the semi-commercial test is actually proven in the commercial tests to be made. There now seems to be no question about its being worked out satisfactorily. The increasing cost and scarcity of wood labor has both reduced the supply and increased the value of hemlock bark. And in addition, the inability of the lumbermen to deliver peeled pulp wood to the pulp manufacturer has further increased the cost of this commodity.

Utilization of Government Pulp-Wood Resources

The woods of the national forests, particularly those of the West, have been the subject of an intensive investigation looking toward their utilization by both mechanical and chemical processes. All the more important pulp-wood species have been investigated and samples are available on practically all the woods of importance from a pulp-making standpoint. Local and economic conditions still remain to be studied and since a great deal of this work was done prior to 1914, the greatly changed conditions necessitate a further survey.

Sulphite Pulp from Resinous Woods

Sulphite pulp can best be produced from the non-resinous woods, and the decreasing supply brings into

importance the possibility of reducing resinous woods by this process. A successful solution of this problem would make available many cheap woods which cannot now be used and to a decided extent assist in overcoming the wood shortage.

Utilization of By-Product Sulphur Dioxide

The possibility opened by the use of liquid sulphur dioxide, which can be obtained from the smelters, in the manufacture of sulphite acid, has been a subject of much speculation, and while semi-commercial scale studies have pretty clearly indicated the results to be expected, it still remains for a mill-scale demonstration to be made. The largest source of this material is, of course, in the West, and in addition to offering an outlet for an extremely objectionable nuisance, it would go far to eliminate the damage to which all vegetation in the vicinity of a smelter producing such fumes is subjected.

Outlook for Sulphite Liquor Utilization

In line with the policy of conservation of by-products, investigations have been planned and carried out on the uses of waste sulphite liquor for the production of alcohol, binders, tanning materials, etc. When one considers that approximately one-half the weight of the wood is dissolved during the course of the cooking treatment and ordinarily runs to waste, some idea may be gained of the immensity of this problem. It may be that in time to come, the relative importance of the products of pulping may be reversed, as was done in the coke industry.

The "Pitch" Problem

Hardly a sulphite mill exists but what experiences trouble with "pitch," and in spite of this, but little has been accomplished along the lines of pitch elimination. The Laboratory equipment is too small to permit a comprehensive study to be made of this problem, but analyses in conjunction with changing cooking conditions will doubtless throw a great deal of light on the subject.

Study of Cooking Conditions

The study of fundamental cooking conditions in the soda and sulphate processes led to the development of a modified method of producing the sulphate pulp. By this method decreased chemical and steam consumption and increased yields were obtained, and while it has been impossible to conduct an entirely satisfactory mill-scale trial, no doubt exists but that this method is worthy of wide use.

Bleaching Sulphate Pulp

Although sulphate pulp is not usually considered as easy-bleaching, indications are that it can be bleached successfully, yielding a fair color with a higher ultimate yield than wood pulped by the soda or sulphite process. A pulp-and-paper-making trial has just been completed where southern pine pulped by the sulphate process has been bleached and used to a large extent in the production of a satisfactory magazine sheet. This has been done without undue cost or sacrifice in yields.

Diffusers and Pans

One of the questions which is very frequently the subject of conversation when sulphate-mill men get together is the relative advantages of diffusers and pans. This problem, however, can only be successfully attacked upon the mill scale, and the same applies to a study of the cause of corrosion of diffusers.



Plant of Marathon Paper Mills Co., Rothschild, Wis.

Recovered Chemicals Reduce Cost

The successful recovery of chemicals from the waste liquor has always been of great importance, and any means which can be devised to raise the percentage of recovered chemicals would immediately be reflected in a decreasing cost for manufacture. Here again but little can be done upon a small scale.

Study of Sulphate Waste Liquor

Paralleling the recovery of by-products from sulphite liquors, distillation of those obtained in the soda or sulphate process offers a means of more fully utilizing the present waste. It is definitely known that valuable products exist in the black liquors, but their recovery upon a commercial scale is not yet a complete success.

Use of Niter Cake

Salt cake has been universally used in the sulphate process to make up the chemical losses, but the use of niter cake offers certain advantages which, however, are offset by a few serious drawbacks. If opportunity could be given for a thorough investigation into the use of niter cake, this problem might be solved.

Sulphate Smelter Lining

A constant source of trouble in the sulphate mill is found in the refractory material used in lining the smelters. While the conditions existing in a sulphate smelter doubtless offer great difficulty, it is not inconceivable that by intensive study a solution for this problem can be found.

By-Products of Alkali Wood Pulp

Woods which are pulped by the alkali process, lend themselves very readily to recovery of various products prior to pulping. So far, however, tannin is the only product which now is recovered on a commercial scale, but the high rosin and turpentine content of the southern pines suggests that before long these materials will also be recovered. This problem can very successfully be attacked upon a laboratory scale and has already been too long delayed.

Pulp-Grinding Stone

There are but few quarries in this country where a successful grade of stone for pulp-grinders is found. The cost of the work necessary to experiment with new deposits is practically prohibitive unless the investigations first can be carried out upon a laboratory scale. Closely connected with this problem is that of developing a suitable artificial stone, and while many abrasive materials have been suggested and some tried, the problem is not as yet unsolved. But here again the laboratory can be of great assistance.

Control of Mechanical Pulp Production

The importance of keeping under control the production of mechanical pulp is receiving increasing at-

tention, and a number of years ago was the subject of some study. Since that time, however, no opportunity has been presented for the Laboratory to continue this work, although mill organizations are carrying on investigations along this line.

Fibre Losses

The loss of fibre in whitewater has been the subject of much discussion in the past, both from the standpoint of stream pollution and improving plant conditions. Because of the large volume of water which must be handled in order to recover the relatively small amount of fiber, certain difficulties present themselves at the start. But progress has certainly been made in the solution of this problem, and much more can be done if the matter is made the subject of an intensive study.

Pulp Beating

The effect of the various factors entering into the beating of pulp is not entirely understood, although progress is being made along these lines. In spite of the work that has been done with experimental beaters, it is not yet possible to apply the results obtained upon a small scale to mill conditions.

Reworking Special Waste Papers

Conservation of waste materials directs attention to the recovering of various waste papers such as paraffine and asphalt. Because of the difficulty of collecting these waste products, but comparatively little progress has been made, although the laboratory tests have successfully demonstrated that the impregnating material can be recovered without undue cost and the extracted pulp made into a satisfactory sheet. One mill is now being built for the extraction of paraffine and the manufacture of the waste paper into pulp.

Aluminum Sulphate Substitute

The study of a substitute for sulphate of alumina is a problem of utmost importance at this time. If transportation conditions remain as they are today, and seemingly no miracle is going to happen to change these conditions under from three to five years, then we shall need some substitute for this commodity which we can obtain easily, possibly from some materials now employed in our pulp-making industry. The conditions in the manufacture of sulphate of alumina today are a serious problem for the paper manufacturers. I understand some work has already been done along that line.

Modified Cellulose

The study of paper specialties such as fiber containers, indurated ware, molded articles, artificial silks, twines and textiles requires a highly organized research body, and progress has necessarily been slow along these lines. Work has been done in an attempt

to develop water- and grease-proof containers, and a certain degree of success has attended the efforts.

Available Paper-Making Fibers

Various raw materials other than wood are receiving an increasing amount of attention from the trade. Utilization of cotton linters has been successfully carried to commercial scale operations. Others such as the various grasses, straws and crop plants should be the subject of investigations, but must await the solutions of those problems which are more pressing and which promise more valuable results.

Cellulose Chemistry

Studies on the chemistry of pulps have been confined principally to the research carried on in the European countries, although the subject is of great importance in connection with the use of chemical pulp for manufacture into various cellulose derivatives. The lack of this knowledge was very forcibly brought home during the war when investigations of the suitability of chemical pulps for manufacture into nitro-cellulose were seriously hampered by our ignorance of the subject.

In the study of pulp wood and wood pulp decay, chemistry will, undoubtedly, play an important part in determining the various decomposition products formed by the decay organisms. However, it must be remembered that in all cases where a chemical study of pulp or wood is made, complete data must be available relative to the previous treatment which the material has undergone. Too much work has already been done upon pulps whose origin was unknown. Of the various studies mentioned, this one alone requires the services of several highly trained men and results could in no case be expected under several years' time.

Pulp-Wood and Wood-Pulp Deterioration Tightwaditis in the Industry

The beginning of the study of the problem of deterioration in pulp-wood and wood-pulp to any great extent in the Laboratory, was brought about by the experience we were having at the mill in which I am interested, with fungus growth in stored and purchased pulp.

Owing to the serious problems of transportation during the war, it became necessary to purchase wood pulp in full cargoes and store it rather than to depend on regular shipments by rail or freshly ground wood. This storing of large quantities of pulp and particularly in view of the high market value at the time, soon impressed one with the enormous loss due to deterioration both in money and quality of product. When this problem was taken up with the Laboratory it was found that practically all the funds were tied up for other work and that even though the funds were available, the necessary pathologists and others necessary to the prosecution of the work must be found. It was impossible to do anything until funds could be supplied and according to regular practice this would mean waiting until appropriations were made and the money available after July 1.

This meant a delay of nearly a year and consequently I undertook to raise sufficient funds from concerns engaged in pulp and paper manufacturing to defray the expense of this work until regular governmental appropriations would be made to cover it. Twenty-three concerns contributed \$10,500; about one-fourth of the concerns addressed on the subject replied to the first appeal and the reasons given by others for not contributing after the second and third appeals were made, showed that there was either a lack of

knowledge on the part of many manufacturers both as to their own needs and as to the ability of the Forest Products Laboratory to handle such questions, or there is an epidemic of *tightwaditis* in this country when it comes to sensible propositions which are to be of benefit to our own business and the country generally.

Let some one present a proposition involving the expenditure of millions of dollars for the assistance of some fool thing or other and men seem possessed to be the first on the list to give their personal or company funds; but a sensible program looking to the conservation of one of the greatest assets this country possesses, is passed up without giving any financial aid and by offering excuses, usually too thin for any use.

Many said, we are studying this problem in our laboratory, but we had all done that for years and were no nearer a solution of the problem than when we started. It requires the best men obtainable in the country in several different lines and it must be patent to every one that a coordinated program being carried out in one place under such conditions as exist here, would yield better results than if men equipped with only general chemical knowledge and working individually should undertake the study of this problem in private laboratories.

Some replied that this should be a government matter and the Government should provide funds, etc., not seeming to realize that funds were not then available and that the loss to every manufacturer due to a delay of six or eight months in the solution of such a problem meant many times the amount they were asked to contribute.

Conditions of the Laboratory's Fullest Usefulness

If the Forest Products Laboratory is to be of the greatest possible assistance to the pulp and paper industry, closer co-operation must exist with the mills, for the final test of any laboratory trial must take place in the mill. Too often information vital to the successful prosecution of a problem is withheld or full and hearty co-operation is lacking. If the mills refuse to give the Laboratory their full confidence and at the same time maintain a critical and unsympathetic attitude, but little real progress can be made on those problems in which the industry is vitally interested.

If, however, they look upon the Laboratory as a part of their own organization and treat it as such, correcting its mistakes and commending its successes, the greater portion of any research is already solved.

For an organization of this character to be so seriously hampered, both as to equipment and personnel, is fatal to a rapid solution of the many problems with which it is confronted, and it is, of course, impossible to carry on intensive studies of the many pressing questions. Should a mill organization desire work done, the results of which would be of benefit to the whole industry, a co-operative arrangement can be made similar to the ones now in force with respect to pulp-wood and wood-pulp decay and pulp-wood measurement. Or one or more men financed by the mills could be detailed to the laboratory for an intensive study of some problem under the direction of the laboratory organization. Either of these suggestions are in accordance with the laboratory policy of furthering the advance of exact knowledge of the industry with which they are so closely connected and their adoption by any organization is most heartily welcomed.

Summary

In summing up the problems of the pulp and paper

industry perhaps the one which is as important as any is in seeing that ample appropriation is made for the continuance of this work, so that with the necessary funds the personnel of the Laboratory may be built up to a point where we may rest assured that the problems confronting us may be solved.

The necessity of such action rests not only on the paper and pulp industry but on every other branch of forest products conversion industry in the country. From my conversation with lumbermen and others connected with the wood-working industry, I am convinced that there is a woeful lack of information as to this work and the possible advantages of it to the individual concern.

Take for instance this problem of deterioration of pulp-wood and wood-pulp, experiments have demonstrated enormous losses in yield from infected wood and a falling off in quality which is surprising. Heretofore, deterioration of pulp-wood and other forest products has been looked upon as a matter of course and no great effort made to correct it. We have heard of the rapidly decreasing timber supply; public men preach about it and newspapers harp on it continuously. Conservation has been preached by every man who could get an audience. Lumbermen and others of days gone by have been criticised for what was at that time an unavoidable waste of unsuitable timber and what was a necessary waste to open up what is now our best agricultural territory.

Criticism of everybody and everything has been the order of the day; but when it comes down to a proposition to finance this Laboratory, the only department of the Forest service which can point the way to conservation of our natural resources after they are removed from the land, it is only after the greatest effort on the part of the Secretary of Agriculture, the Chief Forester and all other connected with that department, together with the efforts of various associations of the industry, the splendid work of some newspapers and trade journals and the actual work in Committee of Congressman Nelson and Senator Lenroot, that Congress would appropriate barely enough to keep this institution alive for another year.

Another strange fact is that within a few months of the time the appropriation was fixed for the Laboratory, another Committee made up of men from the same body which considered the appropriation, tack on to another bill an appropriation of \$100,000 for the investigation of a substitute for pulp-wood. The same old story of finding substitutes for pulp-wood but doing mighty little to find ways to save what we have. Probably none of those who dealt with the Underwood Bill recalled that there was a well-equipped Laboratory for this purpose which they had not properly supported.

If these gentlemen are sincere when they preach "Conservation" then their actions in providing for this institution belie their words. Most people lose their sense of proportion when dealing with large problems and unfortunately Congressmen have proven no exception to this rule.

There is but one thing for the paper and pulp industry and other industries using forest products to do, and that is to work earnestly for a better understanding of the possibilities of this Laboratory service both on the part of the members of their respective industries and of those who have the responsibility and power to fix the sum which shall be expended in this work. In this manner we may expect to reduce materially the number of problems which confront the pulp and paper industry and other industries as well.



Wood-Destroying Growths on Hemlock Pulp-Wood

Personal Items

Francis W. Smith has been transferred from the Elizabeth, N. J., to the Boston, Mass., branch of the American Agricultural Chemical Co.

* * *

Henry W. Newton has resigned the managership of the chemical department of Hartmann Pacific Co., Inc., Anderson, Meyer & Co. and Pacific Commercial Co., all subsidiaries of the Pacific Development Corporation.

* * *

John B. Gordon has transferred his connection with the oil department of Rogers, Brown & Co., to that of purchasing manager of the Capitol Refining Corporation, Washington, D. C. G. Austin Wharry, Mr. Gordon's assistant in his former position, is now with Marden, Dith & Hastings, 136 Liberty street, New York, in the oil and grease department.

* * *

James T. Newton, Commissioner of Patents, has resigned. Mr. Newton was appointed fourth assistant examiner in the Patent Office in 1891, and served through the grades of assistant examiner, law clerk, chief clerk, principal examiner, member of the board of examiners-in-chief, assistant Commissioner of Patents and Commissioner of Patents. Mr. Newton's resignation comes on the top of the resignation of over a score of men in the Patent Office during the past year, caused by inadequate compensation which legislation of the last Congress failed to correct.

Potash Production in the United States

INCOMPLETE returns thus far received from the producers by the United States Geological Survey, indicate that 110,309 short tons of crude potash salts, containing 30,899 short tons of available potash (K_2O), valued at \$7,889,440, was produced in the United States by 73 firms in 1919.

In 1918 there were 128 concerns operating plants, which produced 207,686 short tons of crude material containing 54,803 short tons of available potash (K_2O). In 1917 only 95 firms were operating plants, which produced 126,961 tons of crude material containing 32,573 short tons of potash (K_2O). The production in 1919 was therefore not quite equal to that in 1917 and was little more than half that in 1918.

Plants Reopened

More than 60,000 tons of domestic crude potash material was in storage in January, 1919, and most of the plants were closed for a part of the year, some of them for the larger part. These conditions were brought about by the expectation of large imports of potash salts from abroad—an expectation that was not realized. Instead, the stored material was sold, and many of the plants were reopened in the autumn, though some of them were again obliged to stop work because of shortage of coal.

The potash produced in the United States during the first three months of 1920, as reported to the Geological Survey from 43 plants, amounted to 42,008 short tons of crude material containing 11,969 short tons of available potash (K_2O), valued at \$2,738,195.

Natural Brines

The only notable gain seems to be an increase in production from natural brines elsewhere than in western Nebraska. In 1919 six plants that produced potash from these brines made an output of 11,293 short tons of potash (K_2O). In the first quarter of 1920 five plants working the same brines produced 4,104 short tons of potash (K_2O), and if they continued production at the same rate during the entire year they would produce 16,416 short tons. The production of potash from cement kilns is proceeding at almost exactly the same rate in 1920 as in 1919, although there were only 7 producers in the first part of 1920, against 13 in 1919.

Alunite was used in 1920 only in experiments made by companies that reported production of potash from this material in 1919.

The following tables, compiled by M. R. Nourse, show the production of potash in 1919 and in the first three months of 1920:

POTASH PRODUCED IN THE UNITED STATES IN 1919, CLASSIFIED ACCORDING TO SOURCE.

Source	Number of producers	Production of crude salts (short tons)	Available potash (K_2O) (short tons)	Percentage of total	Total value	Percentage of K_2O in crude product
Natural brines:						
Nebraska lakes.....	8	35,537	9,045	29.3	\$1,880,416	22-28
Other brines.....	6	32,385	11,293	36.5	2,875,908	11-50.5
Total.....	14	68,222	20,338	65.8	\$4,756,324	.....
Alunite.....	5	6,594	2,293	7.4	688,055	8-52
Dust from cement mills.....	13	11,750	1,238	4.1	272,090	2.5-60
Dust from blast furnaces, silicate rock and kelp.....	7	2,200	250	.8	62,035	3-32.5
Molasses distillery waste.....	6	8,498	2,792	9.0	801,331	14-39.8
Steffens waste water.....	8	12,459	3,616	11.7	1,078,291	9.5-44.5
Wood ashes.....	20	586	352	1.2	227,314	60
Total.....	73	110,309	30,899	100.0	7,889,440	.....

POTASH PRODUCED IN THE UNITED STATES IN THE FIRST THREE MONTHS OF 1920, CLASSIFIED ACCORDING TO SOURCE.

Source	Number of producers	Production of crude salts (short tons)	Available potash (K_2O) (short tons)	Percentage of total	Total value	Percentage of K_2O in crude product
Natural brines:						
Nebraska lakes.....	7	23,237	5,859	49.0	\$1,280,819	22-28
Other brines.....	5	9,726	4,104	34.3	956,161	15.8-56
Total.....	12	33,063	9,963	83.3	\$2,216,980	.....
Alunite, blast furnace dust and silicate rock.....	3	1,336	565	4.7	174,912	9.8-52
Dust from cement plants.....	7	4,015	314	2.6	44,246	2.3-35
Wood ashes.....	14	108	65	.5	36,371	60
Steffens waste water.....	3	1,870	440	3.7	118,666	12-42
Kelp and molasses distillery waste.....	4	1,616	662	5.2	146,720	26-51
Total.....	43	42,008	11,969	100.0	\$2,738,195	.....

American Institute of Fertilizer Chemists

The American Institute of Fertilizer Chemists on August 2 and 3, at Baltimore, Md., effected a permanent organization, following the initial meeting in June at White Sulphur Springs, W. Va. The officers of the temporary organization, noted in the last issue of CHEMICAL AGE, were installed and the constitution and by-laws adopted.

Dr. Frank G. Parker, of the Parker Laboratory, Charleston, S. C., the president, occupied the chair. Others present were: A. G. Stillwell, of the Stillwell Laboratory, New York, vice-president; W. J. Gascoyne, Jr., of Gascoyne & Co., Inc., Baltimore, treasurer; Samuel W. Wiley, of Wiley & Co., Inc., Baltimore, secretary; Thomas C. Law, of Law & Co.,

Atlanta, Ga.; Charles W. Rice, of Rice & Simpson, Columbia, S. C.; Philip McG. Shuey, of Shuey & Co., Inc., Savannah, Ga.; Ralph W. Bailey, of Stillwell & Gladding, New York; Philip E. Chazal, of Shepard Laboratory, Charleston, S. C.; B. H. Morrison, of Hamlin & Morrison, Philadelphia.

Codification of analytical methods was arranged for; professional responsibilities of commercial chemists in the fertilizer trade and matters appertaining to their economic interests were discussed.

Samuel W. Wiley headed the local committee, which provided in a very satisfactory manner for the entertainment and accommodation of the visiting chemists during the two-day session.

Oleomargarine and Oleomargarine Legislation in the United States

By J. S. Abbott

Secretary, Institute of Independent Margarin Manufacturers, Washington, D. C.

OLEOMARGARINE has been continuously manufactured and sold in the United States since 1873. The methods of its manufacture and its composition and food value are well known to the margarin industry and nutrition experts, but not so well known to the general public. There is, however, no secret about it.

Procedure of Manufacture

Pure milk, sweet and wholesome vegetable oils, or animal fats, or both, are the foodstuffs which enter into its composition. These fats and oils are churned in ripened milk until a complete emulsion is formed. The emulsion is poured out of the churn through a spray of pure cold water or into a tub of pure cold water which causes the fatty material to congeal into a mass of margarin which floats on top of the water just like butter floats on top of buttermilk in a churn. It is removed from the tub of water to a clean wooden table where it is salted and worked to remove excess water just as butter is worked and salted.

The animal fats used in the manufacture of margarin and the margarin factories which use such fats are inspected and approved by the United States Government. A government inspector stays in such plants all the time. The cleanliness and wholesomeness of such products thus are insured. The milk in which the fats are churned to make margarin is efficiently clarified, pasteurized and ripened under the direction of competent scientists. The butter flavor of margarin is derived from the ripened milk in which the fats and oils are churned. Ripened milk is also the source of the butter flavor of butter. The fatty portion of butter, when separated from butter, has very little if any butter flavor or taste. About one pint of milk is used in the preparation of each pound of margarin.

Types of Margarin

There are three distinct types of margarin in this country, viz., those in which animal fats are used to the exclusion of all other fats; those in which vegetable fats are used exclusively, commonly called nut-margarins; and those in which both animal and vegetable fats are used. The quantity of each type produced is in about the ratio of 1 pound of the animal margarin to 50 pounds of nut margarin to 49 pounds of mixed animal and vegetable margarin.

Food Value and Digestibility

The food value of margarin is well known and recognized by nutrition experts the world over. The United States Food Leaflets issued by the United States Department of Agriculture and the United States Food Administration contain about thirty-five or forty recipes for dishes in the preparation of which fat is used. Four recipes call for the use of butter; one for the use of "butter or butter substitutes"; one for "butter or margarin or other fat"; one for butter or oleomargarine"; twenty-eight for "fat" or "melted fat." Leaflet No. 3 names five essential classes of foodstuffs, one of which is: "Fat, such as drippings, oleomargarine, oil, butter." The particular kind of fat

used in these recipes is not a matter of nutrition but a matter of taste.

The digestibility of margarin, butter and other edible fats and oils is practically the same. According to Lührig the digestibility of margarin and butter is as follows:

Coefficient of digestion of margarin..... 97.55
Coefficient of digestion of butter..... 97.86

According to Dr. Graham Lusk, Cornell Medical School¹, the food value of margarin and butter expressed in calories is as follows:

1 pound margarin.....3,525 calories
1 pound butter.....3,605 calories

The difference in the calories and the digestibility indicated above is negligible, for it is so slight that it could be looked upon as due to experimental error. The composition of these products varies somewhat which will show corresponding differences in the above figures with respect to the food value as often in favor of margarin as against it.

Growth and Production of the Margarin Industry in the United States

The beginning and the growth of the margarin industry in the United States is shown by the following tables:

Table I.—Number of Margarin Factories in the United States.²

In 1873.....	1	In 1900.....	24
In 1880.....	15	In 1914.....	30
In 1890.....	12	April 23, 1920.....	73

Table II.—Margarin Produced in the United States.³

	Colored Margarin, Pounds.	Uncolored Margarin, Pounds.
1903	5,710,407	67,573,689
1908	7,452,800	74,072,800
1913	6,520,436	138,707,426
1918	6,594,790	319,934,049
1919	13,848,576	345,367,995
1920 total of 400,000,000 (estimated) pounds of colored and uncolored margarin.		

Economics of the Industry and the Attitude of Government

A comprehensive discussion of the economics of the margarin industry would make an interesting history. A valuable contribution to the subject has been made by Dr. Edward Wiest.⁴ In view of the unquestionable value of margarin as a food and the fact that it is made of milk and either coconut oil, peanut oil, cottonseed oil, or the government inspected fats of hogs and beeves, or a combination of two or more such fats,

¹The Day's Food in War and Peace.—United States Food Administration, United States Department of Agriculture, Woman's Committee, and Council of National Defense.

²Reports of the Census and Bureau of Internal Revenue, 1919 Annual Report of the Commissioner of Internal Revenue.

³The Butter Industry in the United States. Columbia University Studies in Political Science.—Vol. LXIX, No. 2.—Edward Wiest, Instructor in Economics, University of Vermont.

it would seem that the development of this industry is deserving of the assistance and encouragement of state and federal agencies engaged in promoting the development of American agriculture.

It would also seem that the scientific problems of the production, transportation, storage and marketing of the product are appropriate problems of research not only by such governmental agencies, but by those colleges and universities which are assisting in the solution of the fundamental problems of American industries. Universities are established "for the advancement of knowledge and the promotion of freedom of thought," and "to promote the prosperity of manufactures and the industry of the country."⁵

The United States Department of Agriculture has made favorable references to the use of margarin, as I have indicated. It has also conducted some experiments on the digestibility and food value of margarin, the results of which according to rumor were offered for publication as a bulletin of the Department. If any public money has ever been spent on the development of this industry the writer has not been able to find an account of it.

It is known that millions of dollars of state and federal money have been spent in the study of the manufacture, preservation, storage, transportation and marketing of butter, a manufactured product with which margarin competes and for which margarin is to-day being substituted in this country to the extent of about 400,000,000 pounds per annum. This state of affairs obtains notwithstanding the fact that it is an established governmental policy of this country to assist and encourage the development of American industries, especially those engaged in the production of useful and necessary consumable commodities related to agriculture.

Hostility of Government an Expression of Class Interest

The attitude of our State and Federal governments toward the margarin industry, as shown in the evolution of laws specifically dealing with these products, has been one of continuous hostility. No one questions the wisdom and the necessity of laws for the prevention of the adulteration and misbranding of foods and drugs or even of merchandise in general. According to Emerson this necessity existed in the United States as far back as 1837. He said: "How many articles of daily consumption are furnished us from the West Indies; yet it is said that in the Spanish islands the venality of the officers of the government has passed into usage, and that no article passes into our ships that has not been fraudulently cheapened. . . . I do not charge the merchant or manufacturer. The sins of our trade belong to no class, to no individual."⁶

History of Legislative Repression

The fact that in the early days of its manufacture, margarin was sold, maybe frequently sold, as butter was a sufficient reason for the enactment of laws to prohibit such deception. Some of the early laws, those of Pennsylvania and New York in 1877 and of Maryland in 1878, were in the main designed to prevent such deception. They were, however, not only regulatory in purpose, but they were restrictive in that they prohibited the use of color in margarin. These

laws were not rigid enough for the dairymen. They were followed by prohibitive laws enacted through the efforts of the dairy interests. Between 1880 and 1885, Missouri, New York, Pennsylvania, Maine, Michigan, Minnesota, and Wisconsin passed prohibitive laws. The sale of margarin was prohibited in those states because it was in competition with butter.

Many great thinkers believe that one nation has a right to protect its own industries by levying taxes upon the product of the competitive industries of foreign countries or even by outright prohibition of the importation of such products. But no great thinker has ever advocated the policy of prohibiting the sale of any useful and necessary consumable commodity to protect another such commodity produced under the same flag. These prohibitive laws were declared unconstitutional after the passage of the federal margarin law of 1886. These laws, state and federal, are so vicious that they amount to prohibitive laws in many places.

Results

The taxes placed upon margarin and margarin dealers and the prohibition in most states of the use of color in margarin limit its consumption. The prohibition of the use of color in a foodstuff is not justifiable except when its use would conceal damage or inferiority of the product. This is a fundamental principle of food control recognized the world over. It is embodied in the federal food and drugs act of June 30, 1906, and in the general food laws of almost, if not all, of the states.

Color in margarin is not used to conceal damage or inferiority. The use of it is not prohibited by any of the general food control laws anywhere in the world. Color is put into margarin for the same reason that it is put into butter and everybody knows this but the butter man. And yet the same Congress which put a tax of 10 cents per pound on colored margarin and a tax of \$600 per annum on the manufacturer of it, and a tax of \$480 per annum on the wholesale dealer in it, and a tax of \$48 per annum on the retail dealer in it, this same Congress defined butter as the product usually known as butter with or without added harmless color. Similar taxes have been levied by many states. And this is not all. The laws of some of the states provide that the law enforcing officer be "a practical dairyman." These are acts "For the protection of the Dairy Industry" and "For the promotion of the Dairy Industry," etc.

The "class" that forced the enactment of this "class" legislation enforces the laws against the "class" which they tried to put out of business by prohibitive laws.

The Outlook

These facts ought to make it clear to everybody that our state and federal governments have shown a hostile rather than a friendly spirit towards this industry, which has suffered greatly from these long and aggravated injustices.

The present laws will one day give way to sane, honorable and efficient regulatory measures in harmony with the general principles of food control throughout the world. And when the facts of the manufacture, composition and food value of margarin are learned by all of our American people, its consumption will greatly increase, and the assertions which outstrip evidence as to its food value and economic importance will be considered not only a blunder but a crime.

⁵Science and Culture.—Thomas Henry Huxley.

⁶Man and Reformer.—Ralph Waldo Emerson.

Lithopone

Its Manufacture, Uses and Producers

By George W. Stose

U. S. Geological Survey

LITHOPONE is a valuable pigment manufactured from barytes and zinc. About one-third of the barytes used in the manufacture of barium products in 1918 was ground and floated or otherwise refined and sold as such to manufacturers of paint and other material; almost half was made into lithopone; and the remainder was made into barium chemicals, including blanc fixe, also a paint base. The following table shows the quantities used in these branches of the industry:

Crude Barytes Used in the Manufacture of Barium Products, 1915-1918, in short tons.

Year.	Manufacture of ground barytes.	Manufacture of lithopone.	Manufacture of barium chemicals.	Total.
1915	53,903	44,503	10,216	108,622
1916	75,507	71,898	38,283	185,688
1917	60,132	86,065	49,842	196,039
1918	60,460	85,282	38,041	183,783

Prior to 1914 the market for crude barytes in the United States centered around two localities—St. Louis, Mo., and Philadelphia, Pa. In the St. Louis district the mineral was used chiefly by manufacturers of ground and refined barytes. In the Philadelphia district some domestic barytes was used also in the manufacture of lithopone, but most of the material used for this purpose was imported from Germany. Since 1914 many lithopone and chemical plants have been established, most of them east of the Mississippi and north of the Ohio, so that the chief markets have remained about the same. But a considerable manufacturing industry has sprung up in the South around Cartersville, Ga., Sweetwater and Johnson City, Tenn., and Charleston, W. Va., and smaller operations have been started in Ohio, Kentucky and California.

In Missouri much of the mining is done on a small scale by many operators, and their output is bought by agents of one or the other of several large manufacturing companies of St. Louis, Mo., Mineral Point, Mo., and Chicago, Ill. The J. C. Finck Mineral & Milling Co., of St. Louis, made the largest purchases in 1918, and the Nulsen, Klein & Krausse Manufacturing Co. was the next largest buyer. In the Southern States most of the ore is mined by the larger manufacturing companies for their own use.

Lithopone Manufacture

The process of manufacture is in general as follows:

Barytes is reduced to barium sulphide by subjecting it to the reducing action of carbon, and a solution of barium sulphide obtained. Zinc ore, zinc scrap, or more frequently zinc skimmings and dross from smelters and refineries, is treated with sulphuric acid. The solution of zinc sulphate thus obtained is purified by the removal of all traces of cadmium, iron, or other metals. These solutions are heated and mixed in a large tank, and the chemical reaction that takes place forms an insoluble precipitate composed of 68 to 70 per cent. of barium sulphate and 30 to 32 per cent. of zinc sulphide intimately mixed.

After the precipitate is dried in filter presses and driers, it is heated red-hot in a furnace and then quenched in water. This is an essential part of the process, for it changes the constitution of the powder, making it more opaque and white, and the grade of the product depends largely on the success of this delicate process.

To insure the complete chemical reaction in the process of precipitation, an excess of barium sulphide is maintained. But this excess must be completely washed out to make the product satisfactory. This purification is completed in the final grinding in water of the quenched product and floating it.

In the process of drying and heating, some of the zinc sulphide is changed to oxide, so that from 1 to 10 per cent. of the finished compound is zinc oxide. Some of the compounds here included under lithopone may have a slightly different composition, their exact contents being kept a trade secret, but they are all believed to be barium-zinc compounds of about the same composition. Lithopone is also mixed with zinc oxide, flake white (lead), or other white pigments in various proportions as pigments, and some of these mixtures that are on the market are also probably included under this heading.

Uses

Lithopone is primarily an interior pigment, finding its greatest usefulness as a flat wall paint. Dull-finish wall paint is coming more and more into use on interior walls of buildings and is replacing wall paper in most institutions, such as hotels, hospitals, schools, libraries and factories, as well as homes, especially where indirect lighting is installed. Lithopone is equal or superior to zinc oxide for this purpose, but for paints having a glazed finish, especially enamels, zinc oxide is more satisfactory. Lithopone can be laid on smoothly though not so smoothly as zinc oxide, and in this respect it is more satisfactory than white lead, which shows brush marks and must therefore be stippled in interior wall work.

Properties

Lithopone has many advantages over both white lead and zinc oxide. It is whiter than white lead and equal in whiteness to the best grade of French process zinc oxide. It is not affected by sulphur or hydrogen sulphide as white lead is, and it is nonpoisonous, whereas lead paint is so poisonous that in France and some other countries its use as a paint is prohibited. Lithopone does not blacken by combining with lead contained in pigments or driers with which it is mixed. In opacity or hiding power the pigment is superior to white lead and about equal to zinc oxide, but when it is used in a mixed paint this claim can not be sustained, as the larger quantity of oil used with lithopone reduces its covering power.

As an exterior paint lithopone does not at present give complete satisfaction when used alone, as in direct sunlight it is likely to discolor and turn gray, and its surface becomes chalky and checked. It is claimed that by mixing with lithopone small quantities of other white pigments, such as zinc oxide and whiting (calcium carbonate or chalk), these objections have been

removed. Such pigments made in part of lithopone, which are said to be eminently satisfactory for exterior use, are on the market. A mixture of 60 per cent. of lithopone, 20 per cent. of zinc oxide, and 20 per cent. of whitening ground in pure linseed oil has been recommended for exterior use.

Trade Names

Lithopone and allied pigments are sold under many trade names, nearly every maker having a distinctive name for his own product and claiming for it exceptional qualities. Some of the best known trade names in use are Beckton white, Ponolith, Zincolith lithopone, Sterling lithopone, Marbon white and Fulton white. Some lithopone is still imported under the old name "zinc sulphide white." Various grades of lithopone are recognized in the trade. Green seal is the best and the nearest equivalent of French process zinc oxide; red seal, blue seal and yellow seal are relatively poorer grades. The poorer grades are produced by mechanically mixing ground barytes or blanc fixe with lithopone.

Production

Lithopone was manufactured and sold by nine companies in the United States in 1918, whose production aggregated 62,400 tons about two-thirds of which came from plants in New Jersey and Pennsylvania. Two plants in Delaware and Maryland also produced considerable lithopone. The quantity marketed from the seven plants in the four adjoining States centering around Philadelphia amounted to nearly 52,000 short

tons, a decrease of about 6,000 tons from the output in 1917, the falling off being chiefly in Delaware. Illinois, with two producing plants, also had a large production and marketed 2,500 tons more than it did in 1917. Missouri, the source of most of the ore in the central part of the country, had a relatively small production of lithopone, which was, however, a good start for an industry only two years old in that state.

Producers

The following is a list of the principal concerns engaged in the production of lithopone, or barite-zinc compounds of similar composition and use:

Butterworth-Judson Corporation, 62 Broadway, New York, N. Y.; plant at Newark, N. J.

Chemical Pigments Corporation, 825 Stock Exchange Building, Philadelphia, Pa.; plant at St. Helena, Md., recently acquired by the Glidden Co.

E. I. Du Pont de Nemours & Co., Wilmington, Del.; plants at Camden and Newark, N. J., and Philadelphia, Pa.

Grasselli Chemical Co., Cleveland, Ohio; plant at Grasselli, N. J.

Krebs Pigment & Chemical Co., Newport, Del.; plant at Newport.

Midland Chemical Co., 80 East Jackson Boulevard, Chicago, Ill.; plant at Argo, Ill.

Mineral Refining & Chemical Corporation, Carondelet Station, St. Louis, Mo.; plant at St. Louis.

New Jersey Zinc Co., 160 Front Street, New York, N. Y.; plant at Palmerton, Pa.

Sherwin-Williams Co., 601 Canal Road, Cleveland, Ohio; plant at Kensington, Ill.

Have We Passed the Peak of Soda Ash Production?

SODA ash production for 1919, statistics of which have just been published by the United States Geological Survey, directs attention to the influence of electrolytic methods of caustic soda manufacture upon the chemical procedure heretofore relied upon for its production by the causticization of soda ash.

The following figures show the growth of soda ash production in the United States for five-year periods prior to 1914, and annually since 1916 and including 1919:

Soda Ash Production in the United States, 1899-1919

Quantity (Short tons)		Value		Quantity (Short tons)		Value	
1899	390,653	\$4,859,656	1916	1,194,183	\$16,464,774		
1904	518,954	8,204,545	1917	1,390,625	38,028,000		
1909	646,057	10,362,656	1918	1,390,628	35,635,520		
1914	935,305	10,937,945	1919	981,354	29,824,245		

Walter Weldon, one of the historical figures in the application of the Le Blanc process, in 1883 estimated the entire annual soda trade (carbonate and hydrate in terms of carbonate) of the world to be about 709,000 tons. Comparison of this estimate made 37 years ago with 1919 soda ash production in America alone, indicates the rapid progress of the chemical and allied industries, and reflects the transformation in civilization wrought by this compound.

The following concerns are the most prominent producers of soda ash in the United States, reducing salt by chemical means in contradistinction to electrolytic methods yielding directly caustic soda: Solvay Process Co., Syracuse, N. Y., Detroit, Mich., Hutchinson,

Kan.; Mathieson Alkali Works, Inc., Saltville, Va.; Diamond Alkali Co., Alkali, near Painesville, Ohio; and Columbia Chemical Co., Barborton, Ohio.

The soda ash production statistics given here are notable in the history of heavy chemical manufacture, in that they indicate the peak of production by chemical processes of this essential commodity, and reflect the inevitable restriction imposed by the electrolytic cell on such manufacturing expansion as may be represented by that portion of the product that heretofore has been causticized to obtain the hydrate.

The degree to which such restriction as these figures represent may be progressive, in turn is limited by the outlet for the chlorine of the electrolytic cell.

The remoteness of the time when the alkali industry must depend for its existence upon soda ash production alone, will be determined on the one hand by cheap power and convenient salt accessible to markets for electrolytic products, and on the other, by a consumption outlet for the chlorine, which is produced in equal amounts with caustic soda in the electrolysis of salt.

The exports of soda ash in 1919 amounted to 50,481 short tons, valued at \$2,656,608. This material was shipped principally to Canada, Brazil, Sweden, Mexico and Australia, named in order of decrease in quantity exported. The imports amounted to only 415 short tons, valued at \$12,998.

The new sulphuric acid plant of the Texas Chemical Co., located at Manchester, Texas, on the Houston ship channel, is now in operation. But seven months elapsed from the time the site was inspected until the plant was in operation. Capacity is 100 tons of acid daily. Sol. Piser, of San Francisco, Cal., is president.

The Fibre Container Industry

By J. D. Malcolmson

Industrial Fellow of the Mellon Institute of Industrial Research of the University of Pittsburgh

A FIBER shipping container is a tough, efficient and economical outer package built to withstand the wear and tear of freight, express and parcel post shipment. It is used for shipping all manner of commodities up to a weight limit of ninety pounds. There are two types of these boxes, both equally popular—the laminated walled "solid fibre" box and the cellular "double faced corrugated" box.

Origin of the Industry

The fibre container is an evolution, partly of the ordinary paper carton, and partly of the familiar corrugated straw sheet, used, among other things, as a wrapper for bottles and incandescent lamps. Corrugated paper itself has been in use for some fifty years as an interior packing and wrapping material. More recently, one face and then two were glued to this corrugated sheet to make a rigid board; but it was not until 1903 that experimental freight shipments were made in boxes built from this combined material. Litigation with a wooden box interest ensued and resulted in a victory for the new package. In 1906 the general use of fibre containers for freight shipments was authorized by the railroads, and this marked the real start of the industry.

Its Rapid Growth

The makers of fruit jars and other glass products were among the first to realize the possibilities of the fibre container, and from these small beginnings the industry grew with increasing momentum to its present size. This rapid growth has made it difficult to obtain accurate statistics. There are today, however, some 190 factories in this country making the two types of boxes. Their combined capital is probably in the neighborhood of thirty million dollars, with an annual production valued at about seventy million dollars. It has been estimated that six billion dollars worth of goods moved in fibre containers last year. The industry is still growing at an accelerated rate, with the demand in excess of the supply.

Most of these factories merely fabricate the boxes and built-up boards, although many of the larger plants have their own mills and box factories, forming a self-contained unit of considerable size. One of these, for instance, which is capitalized at \$2,500,000, ships 300 tons of finished product per day and has a sales turnover amounting to seven million dollars a year. The annual tonnage of the entire industry is over 400,000, having increased about 150 per cent. since 1914.

Conservation Inherent in the Fibre Container

Economically considered, the fibre box is an important factor in forest conservation, inasmuch as only about one-sixth of its raw material is new wood pulp, the balance being largely reworked waste paper. This waste paper, moreover, usually contains a fair proportion of old fibre boxes which have outlived their period of usefulness and have found their way back to the paper mill. These savings are in addition to the billions of feet of lumber for wooden boxes that are replaced.

The average fibre box weighs only from two to three pounds, which means a reduction of shipping weight anywhere from 10 to 50 per cent. when com-

pared with the same size wooden boxes. It is shipped flat when empty, and in this form occupies about one-tenth of the space it will contain when set up.

The fibre container affords a very satisfactory means for shipping fragile articles, as well as heavy commodities of relatively small size. Liquids in glass, for instance, are moved in these boxes with a minimum of breakage. The bottles are usually packed in cells formed by partitions of corrugated fibre board. Another method of packing which is in great demand is the "unit carton" system. Articles such as electric irons, lamp fixtures, etc., are placed in an individual carton, which also contains the necessary accessories. A certain number of these cartons, say two dozen, are then shipped in a container, so designed that the contents exactly fill the box. The advantages of this system are that breakage is practically eliminated, the goods are received by the retailer in an attractive condition for displaying on his shelves, and the customer receives the article with its accessory fittings in a convenient and expeditious manner. Many of the larger box makers maintain elaborate designing departments, which are devoted to the devising of new and better methods of packing. This service is usually offered to shippers without charge.

Fibre Box Manufacture

The different stages in the manufacture of the boxes are, briefly, as follows. The sheet materials, such as box-board and straw-board, which enter into the making of a fibre container, are products of the paper industry. They are made by standard paper-making methods, except that the sheets are usually formed on a cylinder machine, rather than on a wire or Fourdrinier machine.

The principal materials used in the manufacture of fibre boxes are:

Wood pulp—chemical and mechanical.

Waste paper—sorted and unsorted.

Straw—for the corrugated sheets.

Silicate of soda—the only adhesive used for assembling the solid fibre plies and the double-faced corrugated components.

Rosin—as a soap, for waterproofing.

Alum—for precipitating the rosin.

Dyes—for coloring the board.

Tape and wire staples—for joining the fourth corner of corrugated and solid-fibre containers, respectively.

Most of the wood pulp comes from spruce, fir and hemlock trees. The chemical pulp is both sulfite and sulfate or "kraft," practically no soda pulp being used in this industry. Most of this pulp originates in the northern forests, although recently some of the southern states, notably Louisiana, have entered the field. Therefore the boxes can be manufactured in many localities and are limited principally by the location of the products to be shipped.

Procedure of the Paper Mill

The pulp, both chemical and mechanical, is shipped to the paper mills, where it is added to the waste paper in the beaters in sufficient quantity to secure the desired strength. Since container board is made on a

cylinder machine, the tendency is to secure beater capacity through the use of a large number of relatively small (1,000-1,500 pound capacity) beaters, rather than the reverse. The board is usually made with a five or six cylinder machine, and this practice enables each cylinder to be supplied by a separate beater. Thus the two end cylinders (forming the outer plies of the board) may be separated by beaters containing pure kraft pulp, while the intermediate ones are using a waste paper furnish.

Rosin size, alum, and coloring matter are added directly to the beaters, whose function is to "brush out" the separate fibres. The "stuff" then passes through Jordon refining engines, which serve to cut the fibres to the proper length, and on to the paper machine by way of the "stuff chests." From the stuff chests, the pulp flows in a very diluted condition to the respective vats. A revolving cylindrical brass screen, known as the "cylinder," is partially submerged in each vat and serves to pick up a thin layer of fibres, which become matted, or felted, as the water runs out through the screen. This thin layer is transferred to an endless blanket, where it meets and attaches itself to the paper layers which have just been delivered from the other cylinders.

After being formed in this manner, the sheet is passed over a series of internally heated drying cylinders and thence to the calendars, where it receives a smooth finish. It is then wound into large rolls, which are shipped to the box factories. These rolls can usually be used for making either of the two types of containers.

Mechanics and Chemistry of the Corrugated Board

The interior of a corrugated board is a scientifically designed truss, which imparts a resilient cushion to the board, increasing its rigidity and resistance to impact. This corrugated portion is made of relatively thin straw paper.

Corrugating straw board is made almost entirely from wheat straw. Most of it comes from Ohio, Indiana and Illinois because of the central location of these states, and because of their supplies of straw and coal. The straw is shipped to the mill where enough must be stored in the season to last until the next season. It is usually stored out of doors in huge stacks often containing 20,000,000 pounds of baled straw.

The straw is cooked with lime and steam in rotary cookers of about seven tons capacity for a period of about eight hours. This mild treatment eliminates many of the impurities, amounting to about 40 per cent. of the original weight. The straw is then drained and loaded into beaters where it is first washed with clear water to eliminate the remaining lime. It is finally beaten and the fibres formed into paper on a one-cylinder machine in a manner very similar to that already described for box board.

Making Laminated Solid Fibre

The principal function of a solid fibre box factory is to build up a heavy board from the rolls of box board. These rolls vary in strength from a weak "chip" paper made of waste news and other weak papers to a strong sheet made almost entirely of new pulp. Such a sheet is known as "jute" board, although jute is seldom actually used at the present time. The tough jute board is used for the outer plies of the solid fibre board, while body is given by building up the interior with chip sheets. These various component sheets may vary from 0.016 to 0.030 inch in

thickness and are combined to form solid fibre boards of three standard sizes—0.060 inch, 0.080 inch and 0.100 inch thick. The sheets are cemented together in a "pasting machine," using silicate of soda as the adhesive.

The board is made in a continuous sheet at a speed of from 100 to 200 lineal feet per minute. It then passes to automatic machines which cut the box blanks out of the sheet. They are also "scored" at this time, so that the flaps and edges of the box will fold properly. After stapling the fourth edge of the box, they are sent through a printing press, tied in bundles and wrapped for shipment.

Corrugated Board

The operations in making corrugated board vary slightly from these, in that the straw board is passed between corrugated rollers which crimp the straw into the desired shape. Adhesive is then automatically applied to the tips of these corrugations, following which the upper and lower facing boards are applied. This type of board is made at a speed of about 60 lineal feet per minute, the subsequent operations being similar to those described for solid fibre, except that gummed cloth tape is used in place of the wire staples for joining the fourth corner.

Fibre containers are usually printed with rubber type and dies. This printing can be done in several colors and offers an excellent means of advertising the commodity being shipped.

Future of the Industry

In these brief paragraphs an attempt has been made merely to touch upon the salient points of a new, yet complicated industry. The future will unquestionably develop still greater opportunities for the use of fibre containers. There is, for instance, an unlimited field in the export trade—one which so far has not been developed, due to the inability of the industry to keep up with the domestic demand.

In spite of this prosperity, the larger and more enterprising firms in the industry have not lost sight of the need of preparation for the future, nor of the importance of constant improvement in quality. Thus, about a score of the more influential fibre box makers have formed a trade association known as the Container Club, whose purposes are to develop and maintain quality, to cooperate with railroads and shippers, and to develop scientific research work in their industry. In the later stages of the war, this association and others interested arranged with the War Department to send a trial shipment of one thousand fibre cases of canned goods to Coblenz, Germany. The experiment was a complete success, for the shipment reached its destination in first class condition, after having been transferred over a dozen times.

The research work mentioned was accomplished by the association's endowing an Industrial Fellowship at the Mellon Institute of Industrial Research. Some of the results of this investigatory work during the past four years will be described in a second article.

The United States Aluminum Co., 120 Broadway, New York, has secured about two and one-third acres fronting on the Hudson River at Edgewater, N. J., as a site for a new plant.

* * *

The American Rubber Products Co., Philadelphia, has acquired the plant and business of Greenwalt & Cohn, manufacturer of kindred products at 1734 North Fifth street, Philadelphia, and will establish headquarters at this location.

Origin, Production and Properties of Stainless Steel

By Elwood Haynes

President, Haynes Stellite Co.

IRON, nickel and cobalt, classified as "metals of the iron group," have similar physical and chemical properties.

Physically they are distinctly malleable, magnetic and possess high tensile strength and high moduli of elasticity. When pure, they take a high polish, and show a distinct metallic lustre.

Chemically each is readily soluble in nitric acid; each forms a monoxide with oxygen, as FeO , NiO and CoO ; each also forms a sesqui-oxide, Fe_2O_3 , Ni_2O_3 and Co_2O_3 . Aqueous solutions of their chlorides, when evaporated to dryness, are transformed into oxides. Their oxides are all readily reduced by either carbon monoxide or hydrogen. Closely related are their melting points and atomic weights, for the latter—that of iron being 56, and those of cobalt and nickel approximating 59. When solutions of cobalt and nickel are mixed, it is difficult to separate the metals one from the other, owing to the fact their behavior under most precipitants is practically the same.

Early Experiments

In 1899, the writer produced an alloy consisting of practically pure nickel and pure chromium by heating their mixed oxides with aluminum. This alloy, when polished, retained its luster, even in the atmosphere of a chemical laboratory, and proved to be practically insoluble in nitric acid, even when boiling. It is also malleable when cold, and under proper annealing can be worked into sheets and wire.

Shortly afterward, an alloy of cobalt and chromium was produced, which not only showed the same untarnishable properties as the nickel-chrome alloy, but possessed much greater hardness. The alloy could not be worked to any extent cold, but was found to be malleable at a bright orange heat.

It was not until 1906 that the alloy was produced in sufficient quantity to fully determine its properties.

In 1909 a cutting blade was made of the alloy, which took an edge comparable to that of tempered steel.

Later, tungsten or molybdenum was added, and an alloy was thus produced which was sufficiently hard to turn iron and steel on the lathe. Later experiments demonstrated that such alloys when properly formed would scratch any steel and would stand up under much higher speeds on the lathe than the best high speed steel tools. This fact gave the cobalt-chromium-tungsten alloy termed stellite (from the Latin word,



ELWOOD HAYNES
President, Haynes Stellite Co.

stella, a star) a field of its own and placed it in a class by itself as a high speed tool.

Properties and Uses of Alloys of Iron-Group Metals

Generally speaking, the cobalt-chromium alloys possess three distinctive properties, viz.:

- (1) Immunity to oxidation under all atmospheric conditions, and to nearly all chemical reagents,
- (2) great hardness, and
- (3) retention of hardness up to visible redness.

Some of the stellite articles for ordinary use are formed from alloys of cobalt and chromium only. This answers well for table knives, spoons, etc. The harder edge tools, such as pocket knives, surgical instruments, etc., contain in addition to cobalt and chromium a certain amount of tungsten to give them greater hardness, while in other instances, a certain amount of iron is introduced into the alloy to soften it so that it may be more readily worked. Such articles include table knife blades, pocket knife handles, certain dental instruments, etc. When iron is added to the alloy, the resulting mixture is termed festel metal, being made up from

the chemical symbol for iron (Fe) and the first syllable of stellite.

This beautiful and easily workable alloy is well adapted for the manufacture of fine door latches, door knobs and high class sanitary fittings for bath rooms, lavatories, etc. It is not malleable except at a bright red heat, but when a certain portion of nickel is added it may be worked cold on the lathe or under the file. By suitable means, it can be given a beautiful stippled surface resembling that of frosted silver, and it is needless to add that it retains its luster under all conditions in the most satisfactory manner.

Some of the later stellite alloys have shown most remarkable resistance to chemical reagents. One of these possessing quite a high chromium content takes a magnificent polish, resembling that of burnished silver. This alloy retains its luster perfectly in boiling aqua regia, and is not affected in the slightest degree after immersion in that liquid for a period of fourteen days. It is slowly attacked by cold hydrochloric acid, but is practically immune to cold, strong, sulphuric acid, and nearly immune to the same acid in the diluted form. It is of course strictly immune to nitric acid of all strengths.

Balance weights have been made of this material

which retain their luster under the most trying conditions. They are immune not only to the ordinary fumes of the laboratory, such as hydrochloric acid, ammonium chloride, nitric acid, hydrogen sulphide, etc., but even to moist chlorine gas. They present a beautiful appearance, owing to their superb luster, and are so hard that their loss from ordinary wear will be perhaps unweighable for several years. There seems to be no good reason why they would not answer equally as well as the more expensive platino-iridium alloys for standard weights and measures.

Excerpts from My Laboratory Notes

In the year 1911, I made some experiments on alloys of iron and chromium with a view to ascertaining definitely their properties. I quote from my notes of November 15, 1911, as follows:

While I have known for some time that chromium when added to iron or steel influences or modifies their properties in a marked degree, I am now engaged in gaining a definite knowledge of:

- a. The effect of chromium on the resistance of steel and iron to chemical and atmospheric influences.
- b. The effect of chromium on the hardness of iron and steel.
- c. The effect of chromium on the elasticity of iron and steel.
- d. The effect of chromium on the cutting qualities of iron and steel.

The preliminary experiments which I have already made along this line indicate that the effect of chromium on iron and steel is much the same as on cobalt and nickel.

I have already prepared the following alloys:

- a. Alloy 20-C. 79.4% iron, 20% chromium, .6% carbon
- b. Alloy 15-C. 84.4% iron, 15% chromium, .6% carbon
- c. Alloy 5-C. 95.0% iron, 5% chromium.
- f. Alloy 10-C. 90.0% iron, 10% chromium.
- g. Alloy 15-C. 85.0% iron, 15% chromium.
- h. Alloy 20-C. 80.0% iron, 20% chromium.

On April 2, 1912, the following was recorded:

A sample of chrome iron was made by melting granulated iron 100 g., chromium 17 g., ferro-titanium 2 g.

The metal fused perfectly and was very fluid. Just before pouring, about 1 g. of manganese was added. The two bars weighed 118 g. The 5/16" square bar was forged into a thin edge, which was quite hard and elastic.

On APRIL 3, 1912:

Fused 100 g. iron, 17 g. chromium, 2 g. ferro-titanium, 3 g. calcium carbide, in a covered crucible same as above. The bars weighed 118 g. The 5/16" bar was hammered into a cold chisel, which would cut iron and soft steel. It was very difficult to file. It should contain about 1% carbon. It did not seem to differ much in hardness from the sample F-2. The crucible was deeply eroded inside, which was no doubt due to the lime from the calcium carbide.

On April 3 the following experiment was recorded:

Mixture H-2, fused iron 100 g., chromium 17 g., carbon 2 g., ferro-titanium 2 g., in a covered "clay" crucible.

The bars were not weighed, but the metal poured clean. The 5/16" bar was forged into a cold chisel. It seemed somewhat harder than the preceding. It forged well, but showed a very small crack at the chisel end, which was ground out before the forging was completed. The chisel showed excellent cutting qualities. It would nick ordinary steel with but little effect on the edge.

The chisel end was heated to about 800° C. and quenched in water. This seemed to harden it to some extent and if pressed hard it would just scratch glass. It takes a fine polish but shows rather dark color. It is not acted upon by cold nitric acid, either strong or dilute, and the acid shows only slight residue when evaporated to dryness on the surface of the metal.

On APRIL 4, 1912:

80 g. iron, 15 g. chromium, 4.5 g. molybdenum, 2 g. ferro-titanium were melted in a covered crucible. The 5/16" bar was forged to a cold chisel edge. It would cut nails, etc., very well, indeed. It seemed also to harden

considerably when heated to an orange color and dipped into water. It was afterwards made into a wood chisel which took a keen edge and showed fine cutting qualities.

On APRIL 8, 1912:

Two 1/2" square by 11" bars were cast, one from mixture F-2, and one from mixture H-2.

Each bar was manufactured into boring bits by the Rockford Bit Works.

Two bits were obtained from each bar and one from H-2 was broken and one from F-2 lost in going through.

These bits were 1/2" in diameter and about 10" long. Just before finishing they were annealed in lead which rendered them sufficiently soft to be filed. They were afterward reheated and allowed to cool in the air, when they became so hard that a file had but little effect upon them. They would bore wood fully as well if not better than an ordinary bit. They hold their luster in the air under all conditions.

Confirmation of Originality

In order to make sure that such alloys were unknown at this time, letters were written to practically all the large steel producers of the United States, asking for a non-rusting or non-tarnishing iron or steel alloy, but the replies received were all of a negative character, and showed that no such alloy existed, but suggested the possible use of alloys of nickel and iron, but in no case was chrome iron or chrome steel even mentioned.

The experiments recorded above distinctly show that the immune or rustless qualities of chrome iron and chrome steel alloys were not only discovered by the writer at the time specified, but that their physical properties were also fully demonstrated.

A Common Experience of Patentees

It is useless, and would be out of place in this connection, to take up the question of patents on these alloys, but as is usually the case, as soon as the patents were granted, a number of persons came forth with similar compositions, claiming that they had used them for some little time, or that they were different in composition from those recorded in the patent. It is perhaps proper to state in this connection, however, that the discovery rests not on the possibility of adding other elements to the steel which may render it more or less immune to corrosion, more easily or less easily workable, but upon the fact that immune chrome steels must contain more than 8% chromium, though for certain purposes they may contain much more than that amount, even up to 60%; that such steels are distinctly workable and useful, whether subjected to heat treatment or not; furthermore, that the proportion of carbon may be raised as high as 2% without materially interfering with the untarnishable qualities of the alloy, though such alloys are, generally speaking, more easily worked if the carbon is below 1%.

The Essential Element of Untarnishability

The following metals may be added to stainless or rustless steel, some of which may contribute slight benefit, while others may be slightly detrimental, namely, nickel, cobalt, vanadium, silicon, boron, tungsten, molybdenum, titanium, tantalum, etc. It is evident that an indefinite number of alloys could be thus formed, some with and some without the above elements, but none would be stainless unless it contained the proper amount of chromium, which is the essential element to be added to nickel, cobalt or iron to produce a stainless alloy.

An Independent Discovery and Some Patent History

About two or three years after the discoveries recorded above by the writer, Mr. Harry Brearley, of

Sheffield, England, discovered practically the same properties in chrome steel, and I am practically certain that his discovery was made independently of any discoveries made by the writer.

Immediately after making the discoveries recorded above, I applied for a patent, but my application was not at first granted, on the ground that chrome steels were not new. Without going into details, I will say that I later made a second application, and that about fifteen days later, Mr. Brearley filed an application for practically the same thing. The Patent Office granted to Mr. Brearley on the ground that his application contained a provision that it was necessary to polish and harden the steel in order to render it immune. This, however, was later found not to be correct, and in May of this year practically all of the claims in the application of the writer were granted by the Patent Office.

A personal service corporation, the American Stainless Steel Corporation, was formed in Pittsburgh, to which both the Haynes and Brearley patents were assigned, and licenses have now been granted to the principal steel makers for the manufacture of stainless steel under these patents.

Composition and Procedure of Manufacture

Stainless or rustless steel consists essentially of an alloy of iron and chromium, containing usually from .1% to 1% of carbon, though the latter element may be present up to nearly 2% without interfering seriously with the working qualities of the steel.

Owing to the high percentage of chromium and its tendency to oxidize at the melting point, even in the presence of carbon, it has been found advisable to melt the steel either in crucibles or the electric furnace. After melting, the metal may be poured into ingot molds in the usual manner, and the ingots thus obtained may be forged or rolled into bars or sheets. If the ingots are of comparatively small size, they will be found to be very hard after casting, especially if they have been stripped hot and allowed to cool rather rapidly in the air. Indeed, small bars thus produced are likely to be almost file hard.

If a small piece of the steel thus produced be placed in a beaker with a piece of ordinary steel and covered with nitric acid, the ordinary carbon steel will be dissolved with great violence while the chrome steel will remain utterly unchanged, thus proving that its immune qualities are primarily due to its composition. This is true whether the steel contains large or only minute quantities of carbon.

Properties of Stainless Steel

Cold chisels cast in iron or graphite ingot molds are sufficiently hard without tempering to cut ordinary iron or steel.

By heating cast bars to a bright orange temperature, they can be forged fairly readily into various forms. After the forging is completed, the metal may be allowed to cool in the air, and will be found to possess fine grain and good cutting qualities.

Quenching in water enhances the hardness to a considerable degree, particularly if the steel contains more than .4% carbon. It is best, however, to use oil for quenching, in order to avoid local contraction stress in the finished article, which might cause it to break under slight shock or jar.

Notwithstanding the comparatively high temperature of working this steel, the bars show almost no scale during the forging operation, and when finished are covered with a blue-black "skin" consisting of a thin film of oxide.

Owing to the absence of deep oxidation and resis-

tance to deformation at comparatively high temperatures, the alloy is admirably suited for casting engine valves, distilling apparatus and for many other purposes of like nature.

When ground and polished, the alloy resists tarnish to a remarkable degree. It is superior in this respect to brass, copper, nickel plate, and far superior to any other steel yet produced. Axes, hatchets, saws or chisels made from it not only will not rust in the atmosphere, but are unchanged when exposed to salt water or salt air. It will likewise doubtless find a large use in the manufacture of propeller blades for steamers, since its modulus of elasticity is much higher than that of bronze, and it resists the action of both fresh and salt water perfectly.

Its great strength and comparatively high elastic limit are likewise in its favor. It will doubtless also have a large application in the manufacture of pump rods, cylinder linings, pump valves, etc.

It is slowly attacked by dilute or strong sulphuric acid, also by hydrochloric acid, but nitric acid has little or no effect upon the polish surface of the metal. It is likewise unaffected, when properly made, by practically all the fruit acids, including strong vinegar.

The alloy will fill a long-felt want among carpenters and others using wood cutting tools, since its freedom from rust, together with its capability of taking a keen cutting edge renders it admirably suited for wood working tools. As noted above, it has been made into augur bits, and these have remained bright for years under all sorts of atmospheric influences.

Industrial Notes

The Morgan-Roche Chemical Machinery Corporation, South River, N. J., has been incorporated in Delaware with capital of \$100,000 by Thomas A. Roche and William Morgan, South River, and E. F. Couch, New Brunswick, N. J., to manufacture machinery for chemical plants, parts, etc.

* * *

The Joseph Stokes Rubber Co., Trenton, N. J., manufacturer of mechanical rubber products, has increased its capital from \$300,000 to \$5,050,000, and will erect plant additions on recently acquired property.

* * *

The Sun Cheong Milling Co., Shanghai, China, a subsidiary of the Pacific Development Corporation, 80 Wall street, New York, has under construction at Shanghai a vegetable oil mill which will be in operation before the end of the year.

* * *

Godfrey L. Cabot, carbon black manufacturer, Boston, Mass., has acquired an addition to his interest in the Salem, W. Va., field represented by the Bristol Gas Co., in his recent purchase of the plant and holdings of the Salem Natural Gas Co., Salem, W. Va. The two concerns will be merged.

* * *

Standard Varnish Co., 90 West street, New York, is celebrating the fiftieth anniversary of its establishment on August 7, 1870. It has to show for its half century of activity an 11-acre plant on Staten Island and distributing agencies throughout the world for its wide range of products.

Present officers of the company are: President, Arthur Davis; vice-presidents, Theodore Robson, Wm. Rosenberg, Edward Robson, James Wolf; treasurer, Charles Schubart; secretary, S. H. King; general manager, J. William Rosenberg.

The Peachey Process of Cold Vulcanization

Historical

The rise of the rubber industry, which was founded in Manchester by the Englishman Macintosh in 1825, to its present position and magnitude may be directly attributed to the discovery by Goodyear, in 1839, of the process known as vulcanization. Raw rubber, which Macintosh employed in the earliest days as proofing for fabrics, is by no means a suitable material from the manufacturer's point of view, for the production of a finished article, in spite of the fact that it possesses a number of unique properties.

Amongst other drawbacks to its use are the facts that it is strongly adhesive, and that it is sensitive to changes of temperature, becoming soft and tacky at a summer heat and stiff and hard in the winter. These defects alone would have sufficed to limit very seriously its uses in industry. In fact, it is safe to say that but for Goodyear's investigations and subsequent discovery, the industry would have been one of minor importance if indeed it had continued to exist at all.

Goodyear found that by incorporating rubber with sulphur and heating for a suitable period to a temperature of about 140° C, rubber becomes profoundly modified and acquires new properties which render it eminently suitable for the manufacture of a host of useful articles. It loses its adhesiveness, becomes resistant to temperature changes, and exhibits greatly enhanced strength, elasticity and durability. A year or two later Hancock, in England, independently discovered the process, his method consisting in immersing sheets or formed articles made from raw rubber in a bath of molten sulphur at a temperature of 135°-140° C. In principle the two methods are the same.

In 1846 Parkes showed that rubber could be superficially vulcanized by immersing it in a cold dilute solution of sulphur chloride in carbon bisulphide. This method is adapted to the vulcanization of thin sheets or films of rubber only.

From these early days up to the present time all manufactured rubber goods have been vulcanized by one or other of these processes, that of Goodyear finding by far the widest application.

Peachey Process

An entirely new process for effecting vulcanization has recently become available as the result of the discovery, by S. J. Peachey, Lecturer in Chemistry at the Manchester College of Technology, that by exposing rubber alternately to the action of two gases, viz., sulphur dioxide and hydrogen sulphide, it becomes rapidly and completely vulcanized, even at the ordinary temperature. The process appears to *Chemical News* (July 2, 1920) to be of fundamental importance for the following reasons:

1. It is true sulphur vulcanization (as distinct from the sulphur chloride treatment) and yields a product entirely comparable with that obtained by the Goodyear process.

2. It eliminates the use of heat, and to a great extent the use of mechanical pressure.

3. It employs two gases, both of which can be produced on the large scale at a very cheap rate.

4. It is rapid in action.

5. It enables the manufacturer to employ organic filling agents such as leather waste, sawdust, shoddy waste, and the like, which cannot be used in con-

nection with the hot process. In this manner a number of cheap and highly durable materials may be fabricated from the various wastes, and employed as floor and wall covering, for boot and shoe manufacture, and for upholstery work.

6. Coal-tar dyestuffs and even natural dyes, which, with a few exceptions, are destroyed by the "hot cure," can be introduced into mixings to be cured by the new process with the production of delicate tints and shades hitherto unobtainable.

The process has the advantage of extreme simplicity, and its translation from the laboratory to the works should prove a simple matter.

Applications

Already numerous samples of daintily colored floor coverings, fancy leathers and felts, suitable for hat making, have been produced in the laboratory, and these have an appearance and a finish which could hardly be improved upon. Several pairs of boots have been soled with leather reformed from waste by the new process, and the practical test of several months' hard wear has shown that the re-formed leather is even more durable than the real article.

The process can be extended to the vulcanization of rubber in solution. If a solution of rubber in benzole or naphtha be saturated or partly saturated with hydrogen sulphide and mixed with a solution of sulphur dioxide in the same solvent, the liquid sets in a few moments to a stiff jelly, and on eliminating the solvent by evaporation a fully vulcanized rubber is obtained.

The use of the mixed solutions for producing perfectly vulcanized seams and joints has proved highly satisfactory in practice, and inner tubes repaired in a few moments by the new process have an excellent life. Further, by the aid of the solution process, reformed leather soles and heels may be attached to boots without the aid of stitching or nailing, and indeed a boot may be produced from the re-formed leather without a single stitch being necessary.

The above-mentioned applications of the process have been fully worked out in the laboratory, but they do not exhaust a fraction of its possibilities. New technical effects in many other directions are continually presenting themselves. The Peachey Process is fully protected all over the world.

Du Pont Fibresilk Co. to Build Plant at Buffalo

The du Pont Fibresilk Company, recently incorporated for the manufacture of artificial silk, has bought a plant site of 100 acres with a frontage on the Niagara River, on the outskirts of Buffalo, N. Y. When the work of construction is completed the company will have a factory area in its buildings of 200,000 square feet. It is expected that operations will be begun some time next spring. About 700 persons will be employed at the works.

The du Pont Fibresilk Company was formed as a result of an agreement between the E. I. du Pont de Nemours & Company and the Comptoir des Textiles Artificiels of Paris, France. The new company will have the benefit of the wide experience and practical work of the French organization, and the extensive experimental work done during the past five years by the du Pont Company.

The offices for the present are in the du Pont Building, Wilmington, Del.

The Cylindrical Electrolytic Cell

By L. D. Vorce

Precision Instrument Co.

RECENT contributions to the literature of the electrolytic cell have been descriptive, with but one exception, of the rectangular or box-shaped type. The vertical cylindrical type, not having been so well advertised, is not so well known.

As the writer is largely responsible for the development and successful operation of a number of cell plants using this type of cell, he may be pardoned for having a paternal pride, as well as a well-founded belief in the efficiency of this type of electrolytic apparatus. Aside from the earlier work of Hargreaves, the beginning of the present development followed a commercial failure of one of the mercury cells.

In the first part of the last decade, an attempt was made to operate an electrolytic plant using the mercury cell patented by G. and G. W. Bell. To move the mercury from one compartment to the other, gas pressure was attempted. After a thorough trial it was found to be a failure, and was abandoned. A. E. Gibbs proposed, as a substitute, the use of a diaphragm cell. The original model submitted was approximately four inches in diameter, and a foot high. The cathode consisted of ordinary perforated metal rolled into cylindrical shape with an asbestos diaphragm within, and graphite rod anode. The cathode was submerged. The contention of the proponent at that time was that a diaphragm cell operating at 70 per cent. current efficiency, and four volts would be a commercial success, and could compete with the Castner mercury cell with its high first cost and upkeep.

The hiatus between this experimental affair and a commercially successful cell is rather considerable. One is reminded of Jasper Whiting's statement before the International Congress of Applied Chemistry in New York that "In my opinion the original idea is seldom worth more than ten per cent. or even five per cent. of the finished process."*

Experimental Development

The attempt to multiply the dimensions of this experimental cell in three directions resulted in building one approximately four feet high, using as large a graphite cylinder for anode as could be secured. This was approximately ten inches in diameter, with a graphite plug screwed into the top for connection. The diaphragm was asbestos paper and cloth. It was evident that considerable deviation from the original idea was necessary to produce a satisfactory cell. The third cell was a considerable departure from the first and second, and resulted in a design which was a decided improvement, and several of its features have survived in the cells as now used. Instead of one large carbon cylinder anode, several pieces of graphite, $2 \times 2 \times 36$ ins., were used. For cathode the indented, or chisel slot opening perforated metal was used, the corrugations appearing inside later constituting the basis for patent claims. It is claimed that the use of this feature was accidental. However, it was found to give good results, and was retained in some of the

plants, although it was conceded that ordinary perforations were just as efficient. The bottom and top rings upon which the cathode and diaphragm were built were of cast iron, covered with hard rubber, as was also the dome, or cover, carrying the anode sticks which depended therefrom. An adjustable feed cup, with overflow for supplying brine and maintaining a constant head was attached to the side of the cell.

About this time it was discovered that in operating a caustic cell, the presence of liquor in the cathode chamber was unnecessary, and, in fact, a detriment, as much better efficiency could be maintained by leaving the outside of the cathode unsubmerged. The credit for this discovery is in dispute and it is not within the province of this paper* to discuss the priority since at the present time all claims covering that feature have expired. This cell is fairly well shown in Fig. 1, Patent No. 874064 of Dec. 17, 1907. This cell was started Dec. 22, 1904, and ten were in operation in May, 1905, when the writer took charge of the plant, and the development of the cell and process.

Between 1905 and the present time a great deal of study and experimental work has been devoted to improvements in the details so that the circular cylindrical cell now presents a materially different aspect from that first shown. It is not necessary to go at length into the details of the changes which were tried from time to time. The main idea was to preserve essential features and to build as simply, economically and substantially as possible, avoiding all moving parts, and maintaining an apparatus easy to build, repair and operate, replacing metal wherever possible with the less corrodible material, concrete composition.

The embodiment of this development is illustrated in Fig. 2, Patent 1,286,844. The design of the cell as now improved is much simplified, the complicated joints for the introduction of the brine supply at the bottom involving over a dozen parts have been reduced to a simple connection. Cement castings have taken the place of the rubber-covered cast iron members. The use of individual feed-cups, entirely unnecessary, is eliminated. The anode is supported independently of the cathode from the outside container, which relieves the cathode from any weight from that member and simplifies the construction.

Comparison of Cylindrical and Box-Shaped Cells

Since the details of construction of the various cells have been published, it is allowable to make parallel comparison of their features for the convenience of those studying the process. In this connection, let it be at once understood that in making this comparison it is not with the idea of criticism of other cells, but rather to bring out for discussion such points as appeal to the judgment and experience of the men engaged in the practice of the art. It is to be expected that men working toward the same end, but differently situated as to place and experience, will travel the same general road, but may differ materially in ideas, guided to a large extent by environment, materials available, and habit of thought.

* Presented at the Twelfth Semi-Annual Meeting of the American Institute of Chemical Engineers, Montreal, Canada, June 28-29, 1920.

* Vol. 21 Report of 8th Int. Congr. of Applied Chem.

Floor Space

With the present high cost of labor and material, one of the first points to be considered in a cell plant is floor space required. The cylindrical cell can be built in any desired size, within limits, but a standard has been adopted for a so-called 1,000 ampere cell which is approximately 26 ins. in diameter by about 40 ins. high. The rating of any such cell is purely arbitrary, as at a slightly increased voltage the current impressed upon a cell can be more than doubled as shown by Wheeler in a recent article. It is customary to set such cells in line on 30-32 ins. centers, with 40 ins. centers between the double lines, with a result that the total working floor space required for this cell does not exceed fifteen square feet. This is much less than that for any rectangular cell. The cell room at the Edgewood Arsenal, housing 1,776 Nelson cells, is 541 x 82 ft., so that the working floor space for that cell of same current capacity is 25 square feet.

The working floor space for the Allen-Moore cell,

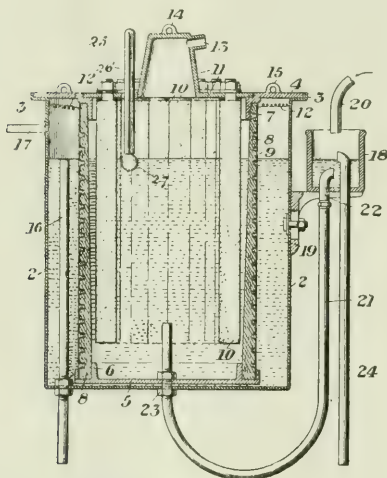


Fig. 1. Cylindrical Electrolytic Cell, Cross Section. Patent No. 874,064, December 17, 1907.

as calculated from data at the Dill and Collins plant, and at the Rirdon Paper Company at Merittan, approximates 90 square feet for the so-called 150 ampere cell, which would be about 60 square feet on a 1,000 ampere basis. From data recently published of a German plant using the Billeter cell, the space required per 1,000 ampere capacity is 70 square feet. The Hargreaves cell occupies about the same space. It is evident from these figures that in this respect the cylindrical cell can be housed in a much less expensive building. If these figures are translated into production per square foot, it is still more illuminating.

The caustic production per day of the cylindrical cell is five pounds per square foot working space.

For the Nelson cell 2.72 pounds per square foot (Their guarantee) (Statement of efficiency of 92 per cent. by Mr. Rollin).

For the Allen-Moore 1.21 pounds per square foot (Their circular).

The production figures and space required are shown in the table below.

TABLE SHOWING CAPACITY OF CELLS.

Cell.	Pounds per day per sq. ft. working space		Sq. ft. working space per ton of product	
	Caustic.	Chlorine.	Caustic.	Chlorine.
Cylindrical ...	5.00	4.43	40	45
Nelson	2.72	2.40	74	83
Allen-Moore ..	1.21	1.07	165	187

Advantages of the Cylindrical Design

The cylindrical design of cell lends itself to extreme simplicity in construction as well as giving the maximum effective operating surface to anode, cathode, etc. It also permits the construction of a cell with a minimum weight. In such a cell there are no massive parts of concrete or metal to add weight without compensating advantages. A standard cylindrical cell will weigh not to exceed 600 to 650 lbs. The advertised weight of the Allen-Moore cell of 1,500 ampere capacity is 2,700 lbs. The light weight of the cylindrical cell is, in large part, obtained by the use of the asbestos-cement parts before mentioned. These are made in special cast iron moulds under pressure and can be made as desired at small expense. They stand the corrosive action very much better than the larger masses of concrete which require reinforcing, and being circular in form, are strong enough for the duty without being heavy. This lighter weight does not in any way detract from its stability, for the cylindrical shape of the cathode is best fitted to bear the strain of the anolyte without deformation to which it is liable on a flat surface. This is of importance in supporting the diaphragm free from ruptures.

Location of Electrodes

In any cell it is essential to get the graphite anodes close to the cathode and diaphragm with as little resistance and consequently as few joints as possible. In this respect the cylindrical cell has a great advantage in that the design permits the use of graphite sticks which are as close to the diaphragm as in any cell, thus reducing the brine resistance to a minimum. The anode is entirely without joints within the cell, connection with the source of power being made from the ends of the rods which pierce the cover of the anode compartment.

Experience has shown that joints in the graphite within the cell not only call for greater labor and expense in assembling, but also add to the resistance of the cell through corrosion by the cell liquor. This can in a measure be minimized by treatment of the graphite to decrease its porosity but that, in turn, increases the resistance of the graphite to the passage of the current. With the arrangement of carbons as described, it is possible at all times to inspect and test the outside connection to locate any imperfect joint. It is palpably impossible to examine any joints where they are within the cell, except when it is shut down. The ability to build a cell without inside joints is considered very important.

Superior Efficiency of the Graphite Anode

Since graphite is the most expensive item entering the construction of a cell, it must be used in as effective a manner as possible. To this end the shape which presents the greatest surface per unit volume is to be selected. In this feature the cylindrical cell again scores, using a graphite stick two inches square. There is thus a surface exposure of two square inches per cubic inch volume. In the Nelson cell with its 4 x 4 carbon this is reduced to 1 square inch per cubic inch volume.

In the Allen-Moore cell, while the surface exposed to the cathode has one inch of surface per cubic inch of volume, these surface blocks are backed up by six inch cubes of graphite which in turn have three inch rods, approximately three feet long, extending up through the cover for the external connection with the result that the total volume of graphite per cell in 6,960 cubic inches for the 2,880 square inches of surface exposed, or one square inch of exposed surface per 2.4 cubic inches in volume.

In the Allen-Moore cell only the wide front surface, that is exposed to the cathode, is considered effective, while with the square anode sticks nearly all four sides are more or less active, as evidenced by the anodes of the Nelson cell which are found to corrode about equally on all four sides. In the cylindrical cell with its smaller size carbon, the action is also found to be upon all four surfaces.

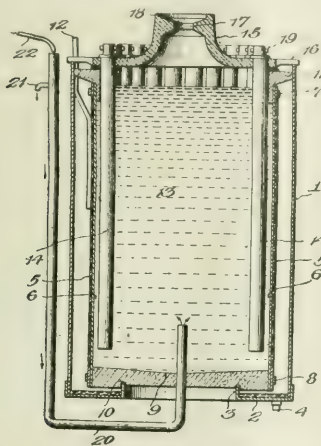


Fig. 2. Cylindrical Electrolytic Cell, Cross Section.
Patent No. 1,286,541.

Greater Ratio of Anode Surface to Total Volume

The ratio of exposed anode surface to total volume in a cylindrical cell is 83.5 per cent. In the Nelson cell it is 75.5 per cent. and in an Allen-Moore 41.57 per cent. The current density per square inch of exposed surface would then be for the cylindrical cell, $1000 \div 5760 = .0174$ amperes; Nelson cell, $1000 \div 2912 = .0342$ amperes; Allen-Moore cell, $1500 \div 2880 = .0522$ amperes. If exception is taken to figuring all four sides of the carbon in the cylindrical cell and the back surface is considered non-effective, it still leaves $1000 \div 4320 = .0231$ amperes per square inch, which still is lower than that of the other cells.

In point of total weight of graphite used, the cylindrical cell requires 214 pounds; the Nelson, 240 pounds; the Allen-Moore 440 pounds.

Conditions of Operating Efficiency

In the matter of efficiency of any cell, more depends upon outside conditions than upon the cell itself. That cell is yet to be built which is fool-proof. Many concerns have shifted from the use of one cell to another when the fault lay in the method of operation rather than in the cell proper. However, all things being equal, that cell is best which can be operated with the least trouble and expense, and the cell which is simplest

to build, generally speaking, will be easiest to operate and maintain.

Since it is power which must be raised and paid for in a cell plant, it naturally follows that power efficiency is the end to which we should aim. A cell operating at 98 per cent. current efficiency and 4.5 volts or a little above 50 per cent. power efficiency is less economical than one at 90 per cent. current efficiency and 4 volts. The cylindrical cell can be, and is, operated at a current efficiency approaching 98 per cent. with a voltage not exceeding 3.6 volts and some cell plants run by the year at an average of 3.54 volts. With such low voltage, over 60 per cent. power efficiency is easily maintained.

With the advancing cost of all material, freights and labor, the ability to operate cell plants locally where chlorine is required for bleaching makes it much more profitable for the paper maker to make his own bleach solutions when, where, and as wanted, than was formerly the case, and the moderate sized unit and flexibility of the cylindrical cell is felt to be a material factor in its favor.

The Business of Radium

As a result of an appropriation of \$225,000 by the New York legislature, the largest single transaction in radium merchandising was effected by the state's purchase of $2\frac{1}{4}$ grams of this element from the Radium Luminous Materials Corporation, for the Institute for Malignant Diseases at Buffalo, to be used for cancer research.

The sale of $2\frac{1}{4}$ grams of radium is notable in that it is the first transaction the extent of which arises above the milligram level. In response to the state's advertisement for bids for this quantity, bids were submitted by the Standard Chemical Co., of Pittsburgh, Pa.; the Radium Co., of Colorado, Inc., 50 Union Square, New York; Corning & Co., Albany, N. Y., and the Radium Luminous Materials Corporation, 58 Pine street, New York, with reduction plant at Orange, N. J., and of which the Radio Chemical Corporation is a subsidiary handling the medical sales.

The successful bidder, the Radium Luminous Material Corporation, was organized in 1915. Its officers are Dr. S. A. Sophochky, president, who is the radium expert; vice-president, Redmond Cross, of Redmond & Co., bankers, and A. Roeder, treasurer. The facilities of the company for recovery of radium from carnotite ore transported from Colorado deposits to the reduction plant at Orange, N. J., will permit a production of 1 gram per month for the remainder of the year.

Corning & Co. represent interests with which radium is a by-product in contradistinction to the other bidders mentioned with whom radium is the main product. Corning & Co. represent the Ludlum Steel Co., which is closely affiliated with the Metal Alloys Co., which produces vanadium for ferrous alloys.

The efficiency of radium in the treatment of malignant diseases provides a ready outlet for the world's production of radium.

The New York Post Graduate Hospital and Medical School is in the market for a gram. The Radio-Chemical Corporation, 58 Pine street, New York, announces the sale of 200 milligrams, valued at \$24,000, to the Physicians' Radium Association of Wisconsin. According to James C. Gray, president of the Standard Chemical Co., his company has sold thus far in July two and one-half grams, portions of this being sent to Japan and Australia, and the balance remaining in the United States.

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A Consolidation of
The Chemical Engineer
and Chemical Age



EDITORIAL

IN a slight draft from the invisible government which never can be dissociated from successful representative democracy, the candle of Elon Huntington Hooker's candidacy for the Republican gubernatorial nomination in New York, flickered, fluttered and went out.

Politics is a profession which has its code, its cliques, its precedents and priorities. Its problem is to win the control of government for the benefit of party machinery.

The selection of Nathan L. Miller, of Syracuse, not only conforms to party discipline, but his experience at the bar, on the bench and as a former financial officer of the state, embraces counselship for the Solvay Process Co., and to that degree the candidate for this high office is kept in the chemical family.

THE formation of the Federated American Engineering Societies as a sort of holding company for the focusing of organized engineering opinion on questions of public welfare for the advancement of the diverse yet closely affiliated engineering professions, is a repeated and a desirable effort, regardless of questions of bureaucratic practicability, to accelerate popular recognition of the work and worth of the engineer.

Present appreciation of the necessity of unity of action among engineering men of all classes, such as is represented by this renewed attempt at federation, has been hastened by the success of the aggression of organized labor, whose example has penetrated engineering ranks in the formation of the Engineers, Architects and Draughtsmen's Union affiliated with the American Federation of Labor; by the indifference of municipal and private employers to the engineer's welfare; by the duplication of effort and dispersion of interest incident to a hundred or more similar local and national engineering organizations; and last, but no means least, by the amazing growth in the past two years

of the American Association of Engineers (over 20,000 members), which, drawing its support largely from the young active element of engineers either held aloof or not attracted by the cool response of the older conservative engineering societies to their economic needs, not only outstripped them in membership, but surpassed them in alert solicitude for group welfare.

THE American Association of Engineers is the answer of young technical professional men to the class-control propaganda of unionism, and reflects their aspirations to recognition heretofore denied to a minority of their kind.

There is no class of men whose potentialities for public usefulness are so poorly utilized as are those of technically educated men.

While unifying organization and publicity will aid in popular appreciation of their service, the responsibility for growth in this direction rests upon them individually.

The vitality of the American Association of Engineers resides in the individual spirit of its membership which finds quick reflection in its executive control; hence its unprecedented growth and practical value to its members.

THIS super-government, this league of nations idea which the American electorate is awaiting the opportunity to unload, is an analogue of the federation which seeks to unify engineers by working from the top down through the machinery of a debating society and employing a political principle early discarded in our national history.

All organization is good if it makes men think and develops that enlightened class consciousness which is a most potent instrument of progress.

Integration and application of technical professional influence in national affairs and in the more immediate matter of the technical man's individual welfare, are demanded by the conditions of our time.

Specialization of function has its drawbacks. It is these that a federation of engineering societies, conceived for the purpose of control and whose *encouchment* was hastened by the conditions stated, hopes to reduce.

THE selection of Conservation and Reconstruction as the keynote of the fall meeting of the American Chemical Society in Chicago, September 6-10, lays timely emphasis on the role of the chemist in social progress, and on his immediate importance in post-war industrial readjustment.

The activities of civilization are the resultant of the reaction of the growth of people in number and in volume and variety of wants upon resources.

That goods shall become more plentiful and less

costly with growth of population, the multiplicity of products of the soil, whether of grain, fibre or mineral, must be the subject of increasing study that the maximum efficiency of their utilization may be attained.

Between the pressure of population and exhaustion of resources stands an economic force which the chemist typifies and expresses in the discovery of new resources and new processes.

The evolution of industry and the progress of man in the amenities of life are the work of this force to which technically educated men impart its vitality.

THE American Association of Engineers in its efforts to procure in many places adequate salaries for its public employe members, has established a wholesome precedent for the new Federation in its contact with government.

Organized labor during the war compelled government agencies to recognize wage rate and living cost discrepancies, and to promulgate rules controlling their adjustment. With its own employes, technical and non-technical, government persistently has refused to conform practice to precept.

The high turn-over of technical workers in government service arising from the superior rewards of private industry, only can demoralize it and make futile the best intentions of capable scientific administrators.

The niggardly attitude of the richest government of the most liberal people in the world towards its technically educated employes is unmatched for ingratitude.

THE treatment of the Forest Products Laboratory, as related by D. C. Everest, General Manager of the Marathon Paper Mills Co. in this issue of CHEMICAL AGE, by politicians beset on the one hand by the necessity for reduced governmental expenditure, and, on the other by the necessity of votes on which their political salvation depends, demonstrates that the fundamental importance of industrial research to efficiency in the utilization of our natural resources, must be kept "sold" to national legislators by some agency on the spot alert to derelictions of national duty.

Other governmental scientific activities are similarly affected, with corresponding failure to function.

There is the economy that conserves and the economy that handicaps and impoverishes.

The direct purpose of government scientific research is to increase production.

Why this purpose should be ham-strung at this time can be explained only by the outstanding characteristic of all work subject to government management, viz., what is everybody's business is nobody's business.

THE pre-eminent educational and commercial event of the chemical year is the National Exposition of Chemical Industries.

That this event has assumed this undisputed importance in five years reflects the concentration of interest upon a fundamental national activity little emphasized until it won the war.

When one considers the intimacy of chemistry to the varied activities of daily life and the fact that every change in the structure of matter is governed by chemical principles and that every manufacturing business based upon these principles is a chemical industry, we approach a realization of the magnitude of the enterprise embraced in the category, "Chemical and Allied Industries," and of how basic and pervasive such enterprise is in our national economy.

From the standpoint of invested capital the manufacture of "chemical and allied products" is secondary only to the industry of "iron and steel and their products," in economic priority.

HERETOFORE material progress largely has been mechanical in that the machine has made possible increased output at a lower cost. The machine cannot react to inadequate supplies. Its output is determined by what is fed to it.

More efficient utilization of present supplies and the substitution for material, often made economically prohibitive by scarcity or inaccessibility, of other material brought by this reason into availability, pre-eminently is the province of the chemist.

This aspect of the chemist's work is outstanding in present industrial growth, notably in such basic commodities as fuel, food, fibres and fabrics, all having intimate relation to the soil upon whose products all progress is predicated.

Chemicals do not reach the ultimate consumer in the shape they leave the plant. In general, they are the essential raw material for the "allied" industries working, relatively to the "chemical" industry, much nearer to the field of final distribution of the vast variety of products into which they enter.

The chemical industry is not only a basic industry, in this respect ranking in its production of alkalis, acids and salts with coal, pig iron and Portland cement; but it is a "key" industry, representing in its output of highly involved products, as explosives, dyes, pharmaceuticals and photographic chemicals, a potentiality for economic distress or prosperity possessed by no other field of enterprise.

Thus the intimate inter-relation of the chemical industry renders it peculiarly susceptible to every influence affecting industrial conditions.

With material progress has come the economic integration of the world, with the result that disturbance anywhere has its reflection everywhere in the continually adjusting equilibrium of production and consumption.

The Future of the Magnesium Industry in the United States

W. C. Phalen

Mineral Technologist, Bureau of Mines

Pre-War Conditions

Metallic magnesium may be considered a war metal, but a war metal with a future, so far as the industry in the United States is concerned.

Its production in the United States prior to 1915, on a commercial scale, was negligible, but imports prior to that year which amounted to about 30,000 lbs. per annum for the years 1912, 1913 and 1914 may be taken as a gauge of the pre-war demand for the metal.

Of this pre-war use, it has been estimated that about 85 per cent. was used annually and in approximately equal quantities in the production of (1) flash-light powder, (2) fire works, (3) aluminum casting work, and (4) nickel and nickel-copper alloys, such as monel metal, etc. The remaining 15 per cent. was employed for general uses, such as deoxidizing brass and other copper alloys in foundry work, and to a small extent in laboratory and research work.

War Conditions

As importations, chiefly from Germany, ceased, the manufacture of magnesium in the United States began on a large scale when 87,500 pounds were produced in 1915. The domestic output decreased to 75,400 pounds in 1916, but increased to 115,813 pounds in 1917, and to 284,188 pounds in 1918, according to figures of the U. S. Geological Survey. These figures do not include the Canadian production, which would probably have brought the total up to 400,000 pounds in 1918; in 1919, if the war had continued, the production in both the United States and Canada could easily have reached 500,000 and possibly 600,000 pounds.

This phenomenal growth was due primarily to the tremendous demand for the metal for special purposes during the war. The plants making magnesium during the war, and since, or which have done experimental work on this metal are: The American Magnesium Corp., Niagara Falls, and Rumford Falls, Maine; The General Electric Co., Schenectady, N. Y.; The Dow Chemical Co., Midland, Michigan; and the Norton Laboratories Co., Lockport, N. Y., and in Canada, the Shawinigan Electro-Metals Co.

Post-War Conditions

Since the close of the war, the demand has approached its pre-war status, indicating plainly that the demand for the metal is not sufficiently well established to warrant continued large production.

With the ending of the war, and the slump in demand, large orders were canceled; and plants whose capacities had been greatly increased to meet war needs, had to reduce their output, seek other markets where possible, or convert to other uses. The Norton Laboratories, Inc., at Lockport, N. Y., converted its plant into a factory for refining tin, and the American Magnesium Corporation, with plants at Niagara Falls, N. Y., and Rumford, Me., worked only at fractional capacity.

During the fall of 1919, there was only one American firm making the metal. However, much research work is being conducted quietly by certain industrial

corporations, and, doubtless, in many private laboratories.

It is not believed that a metal with the commercial possibilities of magnesium, amply demonstrated along certain lines during the war, will continue to remain a rare metal, or that the domestic industry, whose present capacity is largely in excess of domestic needs, and which is, therefore, in a precarious condition, will be supplanted by magnesium of German make. France is said to have developed a small production of metallic magnesium during the war. England, also, produced some of the metal prior to and during the war. In England the supplies of the principal raw material, magnesium chloride, is negligible; but in France, this commodity should become abundant since she has acquired the Alsatian potash field.

The market for magnesium may be expected to develop along lines similar to those along which aluminum developed, but whether to anything like the same extent is entirely problematical. The market is somewhat unacquainted with many of the special qualities of the metal, and increased sales are largely a matter of education and research whereby a demand will be created and developed hand-in-hand with production. Magnesium may possibly replace aluminum in certain applications, but on the other hand, it may lead to an increased consumption of that metal in the form more especially, of alloys containing both metals.

Raw Materials

The raw materials of metallic magnesium comprise both hydrous magnesium chloride and possibly, the oxide. The chloride used in this country during the war was a by-product from the manufacture of salt and bromine from the brines of Saginaw Valley, Michigan, being mostly if not all, supplied through the Dow Chemical Co., Midland, Michigan.

The supply of magnesium chloride contained in the by-product bitters from the solar evaporation of salt along the shores of Great Salt Lake, and the California coast has been practically all wasted in the past. This potential source of raw material is of importance in any domestic magnesium industry. Our principal supplies of magnesite are all located in the Pacific Coast States, namely, California and Washington. This fact, in connection with the water-power facilities in the states, should offer some inducement to parties who contemplate entering the domestic magnesium industry. German competition is the main factor that would have to be reckoned with.

At Salduro, on Great Salt Lake, Utah, magnesium chloride liquor is obtained as a by-product in the manufacture of potash salts. This liquor is suitable for use in making magnesia cement floors and has been shipped in tank cars, but the solid salt, with its water of crystallization, can be recovered only by evaporation at higher temperatures. Plans are under way to prepare this product, which can be used not only in magnesia cement, but to make metallic magnesium as well.

The chloride is also a by-product of the manufacture of potash salts in Germany, and can be produced cheaply in that country as soon as conditions become

stable. This explains why little or no metallic magnesium was produced in the United States or in allied countries previous to the war. However, potential supplies of raw material and the facilities for production in the United States are almost unlimited, if the residue from salt manufacture and our natural supplies of magnesite and dolomite are considered. The whole domestic industry hinges on the cost of the raw material, power, labor and freight rates from California, Washington and Utah, as compared with similar items in and from Germany. In any contemplated magnesium industry near the sources of raw material in the western states, these factors would have to be carefully balanced against those connected with German production and exportation to this country.

Methods of Manufacture

As produced during the war, the raw material, hydrous magnesium chloride ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$), is a by-product from the salt and bromine industry in the Saginaw Valley, Michigan. One producer is reported to have used the oxide as raw material, but little is known as to the operations. Presumably the oxide is dissolved in some mineral bath, as in the case of aluminum, and the magnesium separated by electrolytic reduction.

When the domestic industry started, each producer had to work out his own methods. Doubtless the processes evolved differ from each other, and new applications of known principles were developed. Much effort, time, and money could be saved if all the producers pooled the information they obtained, and a first class process worked out therefrom. This would probably result in cheaper production, and offset to a certain extent future danger, but it is generally thought that the cost of the metal manufactured by the different methods was pretty much the same. Of the different methods employed, general information on one of them, which may be taken as a type, is given below.

Procedure

Water of crystallization is expelled by heating the hydrous chloride over a slow coal fire in small, rectangular, shallow vats, holding about one-quarter of a ton. Common salt, about 25 per cent., and a small quantity of ammonium chloride are added to check the tendency of the magnesium chloride to revert to the oxide throughout this preliminary heat. About 50 per cent. of the water is driven off. With the small quantity of ammonium chloride used, some reversion occurs, but in the presence of sodium chloride the addition of larger quantities of ammonium chloride has not been found to be advantageous, unless in very large quantities, and then the additional cost becomes prohibitive.

Next the partly dehydrated chloride, with its content of ammonium chloride and salt, is removed to cooling vats or molds. After cooling, it is placed in a second dehydrating furnace where the remaining water is driven off and where the ultimate temperature, attained by forced draft, is considerably higher than in the first heat. The reason for completely cooling the batch before placing it in the second furnace is that the temperature has to be increased very gradually to prevent complete loss of chlorine and complete reversion to the oxide.

With all the care exercised during the second heating, some decomposition of the chloride occurs. The chlorine set free is diverted to towers down which water trickles forming dilute hydrochloric acid. The acid solution runs from the base of the towers into

vats containing magnesium carbonate, derived from the refuse oxide from the electrolytic cells by exposure to the weather for an indefinite period. The dilute solution of the chloride thus formed is concentrated by heating until the proper strength is attained, and from this solution the hydrous magnesium chloride crystallizes out on cooling.

Electrolysis

Electrolysis of the anhydrous chloride takes place in cylindrical sheet-iron cells, which serve as cathodes. A low fire is kept burning under the cells to promote fusion. The electrodes used are of graphitized carbon clamped in an iron frame. The charge consists of a few hundred pounds of the MgCl_2 fused with some NaCl and NH_4Cl . A small quantity of charcoal is added to reduce sulphates if any are present. One charge suffices for 24 hours. The furnace man scoops out the slag every hour from the bottom of the furnace in a hand ladle. He then pours the metal, which is about 80 per cent. pure, into small ingot molds holding 2 pounds. This procedure goes on throughout the 24-hour day, each furnace yielding 26 to 28 pounds of metal daily. The metal is, therefore, removed in stages, and at the end of the 24 hours, is practically all removed, when the slag is taken out and the process repeated.

The slag, a mixture of magnesium oxide and sodium chloride, is dumped out of doors and permitted to weather for an indefinite period. Nearly all the salt dissolves and washes away. The magnesium oxide is converted to the carbonate from which the chloride is recovered by means of the chlorine gas from the second dehydration process.

The furnace product is about 80 per cent. pure. It is refined by re-melting in small retorts to 99½ per cent. pure. Oil is the fuel used. While in the molten condition, the impurities, principally the oxide, are removed, leaving the purified metal. This is then poured into molds; after removal from which the ingots are treated with sulphuric acid, to cleanse their surfaces. The ingots are afterwards coated with paraffin to prevent tarnishing.

Magnesium is a light, Sp. G., 1.74, and brilliant silver-colored metal, just a little softer than aluminum. It is malleable and ductile to some extent when cold, but between 350° and 450°C. it is extremely malleable, and may be worked or drawn. It is possible to extrude it into different shapes.

Chemical Properties

Magnesium does not oxidize in dry air, but when exposed to dampness, loses its silver luster and becomes coated with a thin film of oxide which prevents further oxidation. It is not attacked by pure water at room temperature, but at the boiling point (100°C) it is slowly decomposed by pure water with the formation of magnesium oxide and the evolution of hydrogen. A trace of any chloride added to the water will cause the solution of the metal.

Dilute acids dissolve it with violent evolution of hydrogen. It is readily soluble in acetic acid. Strong sulphuric acid acts slowly on the metal. Sulphuric acid and fuming nitric acid mixed have no action at ordinary temperatures. It is not attacked by caustic alkali solutions.

Magnesium may be alloyed with most metals, and with sulphur, phosphorus and arsenic. Oxides of carbon (CO , and CO_2), sulphur dioxide (SO_2) and many hydrocarbons are reduced by the metal at red heat. Silica and boric acids are also reduced by magnesium. When at a red heat, it combines with nitrogen.

It reduces most oxides, liberating the corresponding metal or non-metal. The affinity of the metal for oxygen and its high heat of combustion are indicated by the burning of magnesium ribbon or fine wire. The light which is produced is very strong in actinic rays, hence its value in flash-light powders for photographic purposes.

Uses of Magnesium

The principal uses of metallic magnesium are as follows:

1. As a deoxidizing agent.
2. In alloys.
3. Miscellaneous chemical uses in powdered form, viz.,
 - a. In flashlight photography.
 - b. In fireworks.
 - c. In explosives.
 - d. In miscellaneous other chemical uses.

I. Deoxidizing Agent

As a deoxidizing agent or scavenger, particularly in non-ferrous foundry work, magnesium has proved a most effective agent, owing to its strong affinity for oxygen and its high heat of combustion. Its use should result in the reduction of oxides and the elimination of occluded gases in increased density.

II. In Alloys

As a component of alloys, magnesium doubtless has a wide field of usefulness before it, and promising results already have been obtained, more particularly with low magnesium alloys.

Among the metals with which magnesium may be alloyed are aluminum, copper, nickel, silver, zinc, tin and iron, but it combines with the latter only with great difficulty. Alloys containing more than 10 per cent. are so brittle as to be of little practical value.

Aluminum-magnesium alloys may be obtained in castings having a tensile strength of 20,000 to 25,000 pounds per square inch, but when rolled, hammered, or drawn, the alloys have shown a much greater tensile strength. They are easily turned, threaded, filed or polished, not easily attacked by corroding gases, and retain their polish in the air. They should, therefore, be suitable for ordinary household use in vacuum cleaners, for automobile and airplane parts, typewriter frames, and in pistons and gasoline motor parts as compared with ordinary aluminum-copper alloys.

Such low magnesium alloys are especially useful in articles requiring stiffness. Magnesium, as a component in alloys, is a hardener, and another general characteristic is that it refines the grain of the metal or alloy. A number of new uses may be expected to be found for these low magnesium alloys, as their commercial production is attained at competitive prices with relation to their strength and weight.

In aircraft production, the present tendency is toward all metal planes, and aircraft people have been greatly interested in the metal for this purpose because of its low specific gravity and fairly high tensile strength.

Small percentages of magnesium add to the tensile strength of zinc and should become of importance in enlarging the usefulness of that metal. The reverse is also true, and the magnesium-zinc alloy, containing a small per cent. of zinc is also of commercial interest. The practical application of magnesium in tin alloys is yet to be determined. It is known, however, that a small quantity of magnesium deoxidizes tin, a fact which may have a practical bearing on the tin-plate industry. As magnesium is cheaper than tin per unit

of volume, its possible substitution may be of commercial importance.

The use of magnesium is increasing, and at present the demand appears to be ready for use in aluminum alloys and aluminum casting work, for use in nickel and nickel-copper alloys, for deoxidizing in brass, bronze, and copper casting work, and for use in the production of certain kinds of steel.

The future of magnesium, or of alloys containing magnesium as their major element, is still somewhat of a problem, and the possibilities in their field of research are difficult to prophesy. The addition of small percentages of aluminum, copper or zinc increases the tensile strength, the toughness, and the hardness of the metal. Magnesium and alloys of high magnesium content may be rolled, hammered, or drawn at about 350°C, and they are fairly stable in the air, aside from the thin coating of oxide which forms on the surface. They have the advantage that they are lighter than aluminum per unit of volume, and also are strong and tough.

Magnesium has many possibilities as a commercial metal for specific purposes, especially where difference in price of a particular part is a relatively small part of the total price of the article manufactured.

Increasing the sales of magnesium is largely a matter of education and research, because relatively little is known about the uses of the metal. The fact that magnesium has not been readily cast in wet sand molds but can be cast in dry sand molds and in permanent iron molds, indicate that its future development will require research necessary to produce alloys suitable for die-casting work. It is, therefore, a question of research in the development of a suitable alloy, together with a development of its manufacture, making possible a reduction in price that would result favorably to the magnesium industry.

The present and suggested uses of magnesium as a deoxidizer or as a component in alloys with other metals may be summarized as follows:

ALUMINUM:

- *1. Alloy as hardener and strengthener improving machining qualities; used in proportion of 0.5% to 3 or 4%.

COPPER:

- *1. Deoxidizing agent; used in proportion of 0.02% to 0.1%.
- 2. Alloy as hardener.

BRASS:

- *1. Deoxidizing agent; used as in copper.

BRONZE:

- *1. Deoxidizing agent; used as in copper.

ALUMINUM BRONZE:

- *1. Deoxidizing agent; used as in copper.

MANGANESE BRONZE:

- *1. Deoxidizing agent; used in copper.

NICKEL:

- *1. Deoxidizing agent in the production of castings and ingots for rolling; used in the proportion of .08% to 0.15%.

NICKEL-COPPER ALLOYS, MONEL METAL, ETC.:

- *1. Deoxidizing agent; used as in nickel.

LEAD:

- *1. As a hardener and strengthener; used in percentages less than 5%, usually less than 1%.
 - a. Bearing metals.
 - b. Die castings.
 - c. Casting metal.
- 2. Alloy 15% to 85% to be treated with steam producing hydrogen gas, and lead and magnesium oxides for paints, etc.

*Indicates present commercial use.

STEEL:

1. Deoxidizing agent; in the pure state its action is too violent for safety.

ZINC:

1. Alloy; it produces finer grain in zinc castings and increases hardness and strength.

III. In Powdered Form

The powdered form of the metal was used prior to the war in flashlight photography, and in pyrotechnics of different kinds, together with a small quantity used in laboratory and research work. Probably the total quantity consumed for the above purposes was less than 50 per cent. of the total consumption, approximately divided between the two major uses indicated.

The military use of the powdered metal expanded enormously during the war. After much patient research, the manufacture of the powder was developed in the United States by an American process in 1917. Various sizes are now produced, some as fine as 265 mesh. In powdered form (160 mesh and upward) it is used in flashlight photography, owing to its rapid combustion and its richness in actinic rays. For this purpose it is mixed with such oxidizing agents as the nitrates, chlorates, peroxides, etc. When ignited it does not burn fast ordinarily, but with an oxidizer, as mentioned above, the quickness of its action, together with the high temperature and rapid expansion gives it very great military value. For military purposes, magnesium powder is used in a coarser condition than in flashlight work, namely, 40 to 120 mesh, for flares, star shells, and illuminating bombs. Due to the fact that it gives off a very white smoke (the bright light is useful at night, and the white smoke in daylight), it is used in the production of tracer bullets and special shells for determining the length and accuracy of gun fire.

Great care has to be exercised so that no sparks come in contact with it, owing to the ease with which it oxidizes. The demand for the powder has largely fallen off, and this is the main factor in the slump which the industry experienced during 1919.

The Thermit reaction with aluminum powder suggests the possibility of magnesium powder being used for similar work, though its activity would probably have to be reduced in order to avoid the conditions obtained in the flashlight powder. Small amounts of powder are now used in qualitative chemical analysis. It is also used in ribbon form, and the wire of any specified diameter is procurable.

In the form of powder, it might also be used for the following chemical purposes: (1) A dehydrating agent for oils and aniline dyes; (2) synthetic reagent for the production of alcohols, etc.; (3) in the cyanide process, and (4) as a catalyzing agent.

Future Possibilities of the Metal

The tensile strength of magnesium when cast is higher than that of aluminum, and it is approximately 32 per cent. lighter in weight. It is produced with a purity of 99.5 to 99.9 per cent. This fact is of great importance, considering the demands of modern alloy makers. The importance of a metal with properties similar to that of aluminum, but nearly half as light in weight in these days of enormous automobile and aircraft expansion hardly needs much argument. The outlook is for a larger consumption, both of the pure metal and for alloys containing small quantities of it.

Not so much is known as to the advantages of the rich magnesium alloys, and here is a fruitful field for experiment and research, particularly from the point of view of the producer. Such expansion will require time, and a campaign of advertising. Though the growth should be large, it may be expected to be gradual, as has been the case with aluminum.

Present Conditions

Under present conditions, in which there is a considerable excess in productive capacity over demand, the metallic magnesium industry is in a somewhat precarious condition. The possibility of German competition is also to be taken into consideration. Considering the present exchange rate with Germany, the German competitor can sell the metal in this country considerably in excess of pre-war price, which was about \$1.40 to \$1.60 per pound, and at the same time undersell the American manufacturers. In view of the existing relations with Germany, competition up to the present time has not been of any magnitude, but there is no telling just how soon it will develop, and prove a serious factor to the future of the domestic magnesium industry.

**Preparation of Program of Dye Division,
American Chemical Society for the
Chicago Meeting, September 7-10**

The dye division of the A. C. S., which had its inception first as a dye symposium then as a dye section, is now a duly organized part of the American Chemical Society. The division, under the direction of A. B. Davis, chairman, and R. Norris Shreve, secretary, is undertaking to carry on regular and systematic work for the benefit of the dye industry of America in general, and the users of dyes, manufacturers of dyes, and dye chemists in particular, laying, of course, its especial emphasis upon the chemistry of dyes and dyeing.

It is the duty and the privilege of every chemist in America, who is interested in the chemistry, manufacture, or use of dyes, to enroll himself as a member of the American Chemical Society and of its dye division, to attend and to participate in the semi-annual meetings. The advantage will be mutual, both to the members and to the industry.

To be enrolled in the division, write to the secretary of the division—R. Norris Shreve, 43 Fifth Avenue, New York City. Give to the secretary your address and also inform him if you have ready for presentation any paper on the manufacture or application of dyes and intermediates. Enclose the sum of \$1 as dues for 1920. Dues are for the expenses of the division, consisting mainly of postage and stationery. It is planned as soon as funds permit, to compile and distribute a directory of dye chemists who are registered in the dye division of the American Chemical Society.

There has been some considerable feeling in the past that the concerns should keep all their research work secret, and that none of it could be revealed at such meetings without detriment. However, since every research laboratory turns out a large amount of work which is of very great scientific interest to the trade in general but may have no specific bearing on any process in particular, it may be expected that a large number of papers will be presented of such a nature as to demand the attention of every one interested in the manufacture and use of dyestuffs.

Crude Rubber Production

Ascendency of Plantation Rubber—Production Prospects in the United States.

The position of the crude rubber market presents one of the anomalies of the war and post-war conditions. Since the manufacture of automobile tires absorbs 70 per cent. of the crude rubber that enters this country, these two industries are so closely bound together that their interests are mutual. During the war there was a super-demand for automobiles in a market whose production of cars had been increasing by leaps and bounds. Starting with a production of 65,000 commercial and passenger cars in 1908, in ten years this had been increased to 1,868,947 cars. Falling off in 1918 to 1,153,637 cars, production again mounted, in 1919, to 1,974,016. This rapid growth is shown in the following table:

PRODUCTION OF MOTOR VEHICLES—ALL CLASSES.
(From the National Automobile Chamber of Commerce.)

	Number	Wholesale Value
1908	65,000	\$137,800,000
1909	127,731	167,148,520
1910	187,000	225,000,000
1911	210,000	262,500,000
1912	378,000	378,000,000
1913	485,000	425,000,000
1914	569,045	458,957,843
1915	692,618	691,778,950
1916	1,583,617	954,969,353
1917	1,868,947	1,274,488,449
1918	1,153,637	1,236,106,917
1919	1,974,016	1,885,112,546

The production of crude rubber kept pace with the rapid advance in motor vehicles and in fact over-reached it. The plantation owners of the Far East—largely the British—reached the conclusion in 1917 that the percentage of United States increase in the manufacture of cars was going to receive no set-back and planned accordingly. The result was that in the year 1918, while our output of automobiles fell off by more than 700,000 cars, a surplus of crude rubber was developed, amounting, by the end of 1918, to practically 140,000 tons. Although the United States car output is again on the up-grade, the rubber surplus has not yet been absorbed, and this fact has made for an unsettled market condition ever since.

The price of crude rubber is now at the lowest point ever recorded, the best grades of plantations selling around 34 to 35 cents a pound in the market that is dull, heavy and featureless. When the Amazon was the chief source of supply and before plantation rubber had become an established commercial factor, Para up-river-rubber was the market leader, and commanded fabulous prices as the demand began to over-top the supply; \$3.18 was the high mark, and during 1911 and 1912 prices of rather more than a dollar prevailed. Since that time, as production increased, there has been a steady decline. During the war the Government fixed a maximum price of 62 cents and 63 cents respectively on "smoked ribbed sheets" and "first latex crepe," though many sales took place at figures below those fixed. It was not until the enormous surplus appeared, in 1918, that the bottom really dropped out of rubber—and there seems to be no bottom yet in sight.

Crude rubber is the only commodity of commerce that has been unfavorably affected by the war. There is a reason why there was a surplus in 1918. In the cultivation of plantation rubber vast orchards of trees were planted. There are said to be 2,900,000 acres—a tract of land as large as the entire state of Connecticut—now planted and producing. The problem of production is different from that of other agricultural

products. Cotton, corn, wheat and the like are planted each year, and production can be controlled every year as desired, but rubber trees, once planted and yielding latex, will continue to do so indefinitely, year in and year out. The operation is perennial. The market, therefore, awaits the absorption of the 1918 surplus and the further advance in the output of cars, and it seem apparent that both of these conditions are coming about.

The story of the decline of the Amazon as the chief source of crude rubber supply, giving place to the plantations of the Far East, has seldom been told. It is a story of the passing of unscientific and slipshod business methods for modern, up-to-date practices. The Amazon is the source of all the best grades of rubber where the trees grow in a wild state, but the unhealthy conditions surrounding the gathering of the crop have made it impossible to place the Brazilian industry on a scientific business footing.

On the Eastern plantations, however, with seeds taken from the Amazon, it has been possible to establish the industry on a basis with which the Amazon has been unable to compete. The decline of the one and the rise of the other is indicated by the following table:

WORLD'S PRODUCTION OF CRUDE RUBBER.

(In tons of 2,240 pounds.)

(From Rickinson's "The World's Rubber Position.")

	Plantation.	Amazon.	Other.	Total.
1900	4	26,750	27,136	53,880
1906	510	36,000	29,700	66,210
1910	8,200	40,800	21,500	70,500
1915	107,867	37,220	13,615	158,702
1919	285,000	30,000	10,000	325,000
1920 Estimated.	310,000	28,000	9,000	347,000

The plantation industry in crude rubber is a distinctly British innovation. For thirty years Englishmen experimented with growing Para rubber trees in the tropical Orient before it became a commercial fact—but as soon as this fact was established others came into the field. In 1909 and 1910 the United States Rubber Company made its first investment in rubber plantations, which has developed since into the largest single plantation in the world. It covers an area more than three times the size of the Island of Manhattan, but, even so, it is but a fraction of the total plantation area now operating, the remainder being largely British, widely distributed in ownership through joint stock companies.

But if Great Britain is the producer, the United States is the user of the product, fully 70 per cent. of the crop coming to this country. The magnitude to which this import has grown within the past few years will be seen by reference to the following table:

UNITED STATES CRUDE RUBBER IMPORTS.

(In tons of 2,240 pounds.)

(From the Rubber Association of America.)

1900	21,688	January, 1920	21,351
1905	35,617	February, 1920	32,994
1910	50,522	March, 1920	31,650
1915	86,034	April, 1920	23,675
1917	196,687	May, 1920	27,338
1918	194,799	June, 1920	14,881
1919	231,510		

Notwithstanding the fact of the rubber surplus, still unabsorbed, the best authorities think that, with the present increase in demand made by the automobile, there is likely to be a rubber shortage within a very few years. Messrs. W. H. Rickinson & Son of London are the acknowledged crude rubber statistical ex-

ports of the world, and in their "The World's Rubber Position" of recent date they supply convincing figures to assist those who are desirous of making a forecast of the world's future production and consumption.

Starting with the 1919 consumption of 320,000 tons, they state that the demand has increased in the United States at the rate of 27.7 per cent. a year during the past ten years. Should the demand increase at a rate of, say, 25 per cent. a year for the next four years (a figure they think reasonable), this would amount, in 1924, to double the present figure, or 640,000 tons.

The present rate of production on the 2,900,000 acres of plantation is about 247 pounds per acre, and Rickinson & Son see no way by which the old orchards can be extended during this time, nor how a sufficient number of the new orchards, now planted, can come into the full production necessary to make up this deficiency; neither do they see that the old orchards, which have shown a decreasing percentage of annual increase in quantity of bearing, amounting in 1919 to but 7.8 per cent., are going to help the situation. For this reason W. H. Rickinson & Son predict a shortage in supply in 1924.

Figures like these, coming from such a source, are looked upon as authoritative and the rubber trade, recognizing that something like the above was likely to happen, even before the Rickinson figures appeared, are looking for new sources of supply. The Amazon cannot be relied upon to furnish more than the 28,000 or 30,000 tons it is producing today. The other sources of wild rubber—Central Africa and Central America—have long ago reached their maximum of 9,000 to 10,000 tons a year. The Philippines, although available for plantation production, are out of the calculation because the Philippine government will not permit the introduction of coolie labor—without which successful competition cannot be had with other of the Far Eastern producing centres.

Attention is therefore drawn to the *Chrysosthannus Naucleus* or rabbit bush, a tree growing in great profusion in our arid southwestern states, and long known to contain valuable quantities of crude rubber. The inexact and inadequate information heretofore existing on the quantity, quality and availability of rubber from this source is now being supplemented by scientific commercial investigation, which discloses the fact that the *Chrysosthannus* of the *Naucleus* variety will supply crude rubber of good grade. It discloses that there is at present, growing wild in Nevada, Utah, Colorado and Southern California, a sufficient quantity of this bush to supply 300,000,000 pounds of pure rubber, or nearly half of the present world's yearly production. The investigators report further, that, with proper methods of cultivation and selection, the bush may be made to yield from 15 to 20 per cent. of rubber, and that this source, in time, will be able to supply this country's needs.

The investigations have been carried on by Professors Harvey Monroe Hall and Thomas Harper Goodspeed of the University of California, supplemented by Dr. Herbert J. Webber, who is recognized as being the foremost plant breeder of the United States.

Large quantities of the bark of this bush, from which the rubber is extracted, have been analyzed, treated and pronounced by Dr. David Spense, chairman of the Subcommittee on Rubber and Allied Substances of the National Research Council, to be a potential source of "rubber of high grade and average quality—not as good as the best up-river-fine—but a great deal better than most Africans and low grade rubbers."

Based upon the reports of these scientific gentlemen it is understood that one of the large rubber companies is now making closer investigations into the commercial aspects, costs of production, and other items that enter into a determination of its value as a substitute, in whole or in part, for our supply.

British Prizes for New Uses of Rubber

The Rubber Growers' Association, Inc., of London, is offering prizes for ideas and suggestions for extending the present uses or for encouraging new uses of rubber. The awards consist of: First, £1,000; second, three prizes of £500 each; third, ten prizes of £100 each; and a sum not exceeding £1,500 to be divided among the remaining competitors whose suggestions are considered to be of value, according to the relative value of their suggestions, but so that no competitor will receive more than £100. The total sum offered, therefore, aggregates £5,000.

The association points out that "suggestions must be practical and likely to increase the demand for the raw material. Ideas will be welcomed for the application in new directions of existing processes, methods, or manufactures, or for improvements or new processes which will facilitate or cheapen the production of rubber goods. Competent judges will be appointed to investigate and adjudicate upon the suggestions received."

The latest date for receiving suggestions is December 31, 1920, and no envelopes containing the same will be opened before that time.

Full particulars of the conditions governing this competition can be obtained from the Rubber Growers' Association, Department C, 38 Eastcheap, London, E. C. 3. One important proviso is as follows:

No apparatus, method, or process suggested is to be protected in any country by letters patent or otherwise by the competitor or the Rubber Growers' Association. Every

successful competitor must be prepared, if requested by the Rubber Growers' Association, to make a statutory declaration (at the expense of the association) that he has not made, and does not intend to make, and that to the best of his knowledge and belief, except as disclosed by him in compliance with clause 5 (f) of these conditions, no other person has made or intends to make any application for letters patent (or like protection) in respect of the method, apparatus, or process suggested by the competitor, and that to the best of his knowledge and belief the method, apparatus, or process suggested is not the property of any person other than the competitor.

Clause 5 (f) reads as follows:

In submitting suggestions competitors shall give the following particulars, with such others as they deem advisable: Whether the suggestion is, in the competitor's knowledge, in any way covered by patent laws, or has been the subject of any application for letters patent by any person, or is in any way affected by any letters patent, etc., in any country.

Earnings of the General Chemical Company during the first half of this year were considerably larger than in the same period in 1919. A report for that period shows total profits of \$4,436,472, as compared with \$3,090,432 in the first half of last year. Surplus after charges and Federal taxes amounted to \$3,146,472, equivalent after preferred dividends to \$13.40 a share earned on the \$19,822,900 common stock, as compared with \$1,780,432, or \$8.01 a share on the \$16,519,200 common stock in the corresponding period of 1919.

Composition and Manufacture of Inks

Writing ink is a solution of fine suspension in water of some colored substance which will leave a permanent mark upon paper after drying. It is judged by its permanence, durability and writing qualities. By permanence is meant the resistance which the writing will show to the agents of time, such as light, moisture and moderate heat. The durability is judged by the freedom from the formation of scum, sediment and mold. The writing quality is a factor which must also be taken into consideration, inasmuch as some fluids, in spite of excellent durability and permanence, are unsuited for pen work because of improper consistency, high acidity or insufficient color.*

Carbon Inks

Inks having carbon or a carbonaceous compound in a finely divided state for their pigment have, to a large extent, been superseded by inks in which the coloring matter is more or less in solution.

Sepia, a black secretion of the common cuttle-fish, used by the Romans for writing purposes, is used now almost exclusively in the manufacture of "sepia" for artists. The ink sacs are pulverized, and the powder is triturated with caustic soda and boiled for 20 minutes. The liquid is then filtered, neutralized with hydrochloric acid, and the precipitated pigment repeatedly washed with water and dried at a low temperature. The pigment is ground to a fine powder and made up into cakes.

Indian ink is made from a mixture of glue and lamp-black. These materials are heated together, cooled, and camphor or some such preservative is added. The mixture is then pressed into cakes and sold as a commercial product.

Modern carbonaceous inks are made from mixtures of gum arabic, shellac and borax, with carbon in suspension.

Gallotannate of Iron Writing Inks

Ordinary writing ink consists essentially of an aqueous solution of iron gallotannate, although Prussian blue, chrome logwood, copper logwood and dye solutions are sometimes used. For ordinary work the iron gallotannate has been found to be the most satisfactory. This is the type of ink that has been adopted by the Government. The galls used in the ink are found on branches, shoots and leaves of trees. They are produced by insects, the best known being the gallwasp. The galls contain tannin, gallic acid, ellagic and luteoallic acids, chlorophyll, gum, starch, sugar, proteid, potassium salts and water.

The galls are soaked in water and the extract is used in ink making. The most important substance extracted is a tannin which is given the name of gallotannic acid to distinguish it from other tannins. Tannins vary greatly; they are described as iron bluing or iron greening, according to the color of the precipitate they form with iron salts.

This difference is evidently one of constitution, for one group of tannins can be converted into gallic acid and yield pyrogallol, while the other group does not give these reactions. Only the iron-bluing tannins are suitable substances for the manufacture of black ink,

as has been shown by Schluttig and Neumann, who found that mixtures of various tannin extracts with solutions of iron salts gave bright green colorations on paper, but that after six months' exposure only rust-like stains were left. Tannins are extracted from other sources than galls. Chestnut bark is a source of tannin, which, however, is not as satisfactory for ink making as the tannin made from an infusion of nut galls. Other sources are: Sumac, divi-divi—the name given in commerce to the dried pods of a South American shrub, myrobalans—the fruit of different species of *Terminalia* growing in India, valonia, acorn cups and oak bark. All of these materials, with the exception of the last named, produce iron-bluing tannins. Iron salts are of primary importance in ink making, because they form insoluble, permanent compounds with tannins and produce a black color. The addition of an acid is necessary to prevent precipitation and to keep the iron in solution. For this purpose sulphuric or hydrochloric acid is used. The Government has adopted the following specifications for inks: The ink must be a gallotannate of iron ink, not inferior in any essential quality to one properly prepared after the following formula:

	Grams
Tannic acid.....	23.4
Gallic acid.....	7.7
Ferrous sulphate.....	30
Dilute hydrochloric acid, U. S. P.....	25
Phenol.....	1
Suitable blue dye.....	2.2
Water to make a volume of 1000 cc at 15.6° C.	

Logwood and Dyestuff Inks

In the manufacture of inks where permanence is not a necessary factor many dyes in aqueous solutions are used. For ordinary writing purposes these inks are very satisfactory, because they do not contain acid and have no corrosive effect on pens. A material commonly used for inks is logwood. The logwood is digested with hot water, and the extract obtained is used for coloring. By adding a very small proportion of potassium chromate to a decoction of logwood a deep-black fluid is obtained which can be used as an ink without further treatment. Copper-logwood inks are made by boiling alum, copper sulphate and logwood with water and filtering the solution. The filtrate is a red-violet ink, which writes pure violet, then rapidly darkens.

Ink Tablets and Powders

Ink tablets and powders, as their names imply, are designed to produce ink by being dissolved in water. To be entirely satisfactory the solution formed must possess all the properties of a high grade writing fluid. As stated before, most inks belong to the iron-tannin class.

Several years ago the attention of the Bureau of Standards was directed to ink powders by one of the departmental supply divisions. It was found that these powders contained organic dye, but none of the other ingredients necessary for permanent records. The records produced by these inks were fugitive to sunlight and could easily be washed out with water. It was obvious, therefore, that a suitable ink powder would have to contain the important ingredients of writing fluid, namely, tannic acid and ferrous sulphate.

* Circular 96, Bureau of Standards. Inks—Their Composition, Manufacture and Methods of Testing.

All of the materials used in the manufacture of ink are solid, with the exception of hydrochloric acid, and it is necessary that this acid or some similar material be present in order to prevent the iron from precipitating. Experiments have shown that certain solid substances of an acid character can be used in the place of hydrochloric acid. Failure to use such material will result in a powder which, when dissolved in water, will have a tendency to form a thick scum or sediment after standing a few days. A few manufacturers have thought that the dried and ground residue from ordinary ink could be used. As might be expected, the hydrochloric acid escapes with the water on evaporation, and furthermore, the iron-tannin compound is largely rendered insoluble by the process.

The results of experiments seem to indicate that organic acids or acid salts of mineral acids, in proper amounts, may be used as a substitute for hydrochloric acid.

Advantages

The advantages that would accrue from the use of powders and tablets are many. A quart bottle of ink ready for shipment weighs about 5 pounds and occupies about 275 cubic inches, where the quantity of powder sufficient to make a quart weighs approximately 2 ounces and occupies only 8 cubic inches. Another important factor is the great reduction of loss by breakage, which entails loss of the ink and which may ruin other articles which come in contact with the fluid. The danger of freezing is entirely eliminated. Another point that is worthy of consideration is the superior keeping quality of a powder over a liquid.

There are a few objections to the use of ink powders, viz.: (1) The production of this material is still in the experimental stage, (2) the user must furnish his own container, (3) careless persons may not make up the ink properly, and (4) the water in certain localities may contain ingredients which are deleterious to the ink.

Copying Inks

Most writing inks are capable of yielding one or more copies when pressed with suitable moist paper soon after writing. Thus an ordinary iron-gall ink will give a faint copy before it has become completely oxidized, but when once the coloring matter becomes completely insoluble, copies can no longer be taken. As the process of copying tends to make the original writing too faint, it is necessary to have an additional quantity of coloring matter in the ink, together with a certain proportion of gum or other adhesive material to attach this excess of coloring matter to the surface of the paper and to protect it from too rapid oxidation. Dextrin is sometimes employed in place of gum. Sugar, too, is frequently added for the same purpose; however, it leaves the writing more or less sticky and is, therefore, objectionable. A small amount of glycerol is a common constituent of copying ink, its object being to prevent the gum from completely drying. If, however, it is added in too large an excess, the ink will smudge. Generally speaking, iron gall and logwood copying inks should contain from 30 to 40 per cent. less water than inks of the same formula intended for use as writing inks only. Below is the formula, adopted by the Government, to which all copying inks must conform:

	Grams
Tannic acid.....	46.8
Gallic acid.....	15.4
Ferrous sulphate.....	60.0
Gum arabic.....	10.0

Dilute hydrochloric acid, U. S. P.....	50.0
Phenol.....	1.0
Suitable blue dye.....	4.4
Water to make a volume of 1000 cc at 15.6° C.	

Marking Inks

Of the different substances that have been employed as marking inks the best known and most commonly used has been a solution of a silver salt, the reduction of which in the fibres of the material leaves an insoluble black deposit of a more or less permanent nature. The earliest ink of this type required the linen to be previously treated with what is known as a pounce and then dried, but these inks have now been entirely superseded by others which are reduced by passing a hot iron over the writing.

Marking inks have been made in innumerable ways. One silver marking ink contained water, platinum, silver, tartaric acid, ammonia, gum and a pigment.

Marking inks may contain salts of metals, such as gold and platinum, which are too expensive for general use; also the sulphides of heavy metals, such as iron, zinc and copper, or organic substances, such as nonvolatile fats, in the presence of a suitable metallic hydroxide or sulphide. Aniline marking inks are also made. They consist of two solutions which are kept separate until just before use. The writing done with this ink is not removed by water, but is not very resistant to the action of alkalis. Many patents have been secured for marking inks; among them are "Dimitry's bichromate marking ink," which consists of a soluble coloring matter mixed with gelatin and potassium dichromate, and "molybdc marking ink," prepared by dissolving molybdc oxide in hydrochloric acid and adding gum arabic, sweet wood extract and water. When the writing was dry the linen was treated with a solution of tin chloride.

Many marking inks manufactured at present consist chiefly of cresol and dye.

Canceling Inks

The demand for these inks has come almost entirely from Government departments or from manufacturers who pay the tax on the articles which they produce and, consequently, must cancel the revenue stamps furnished them. The ink must contain pigment and dyes and must penetrate the fiber of the paper of the envelopes and stamps to such an extent that the mark can not be removed by erasure or washing with defacing the stamps sufficient to prevent their use a second time. The inks are quite varied in composition. Lampblack is used as a pigment with the addition of a coal-tar dye; the liquid used as a base for the ink consists of a non-drying oil.

Stamping Inks

The ink used for rubber stamps should be such that, when applied to a suitable pad, it remains sufficiently fluid to adhere to the stamps. At the same time the fluidity should cease by the time the stamp is pressed upon an absorbing surface such as paper. Formerly these inks were made by rubbing up pigments in fat to a paste. Now, since most stamping inks are made from glycerol and coal-tar dyes, the manufacture is

* * *

W. J. Lawson, manager of the Wilhelm plant of the Glidden Co. at Reading, Pa., has been transferred to the managery of the Heath & Milligan plant of the company at Chicago. J. D. Barger, of the latter plant, is transferred to the Campbell plant in New York.

quite simple. The dye, such as fuchsine, methyl violet, water blue, emerald green, etc., is put into a dish and glycerol poured over it; the mixture is then heated to about 212° F. The coal-tar dyes used must necessarily be soluble in hot glycerol.

Duplicating Inks

These inks consist of a mixture of pigment and oil, though rosin soaps in small quantities are sometimes found. Of the pigments the most important is carbon. The iron blues are used to a large extent with the carbon; these are mixtures of ferricyanides and ferrocyanides of iron and potassium. The best known of these pigments is Prussian blue, obtained by adding a ferric salt to potassium ferrocyanide. Ultramarine is used to some extent. The true ultramarine is the mineral lapis lazuli. This is too rare to use. What is commonly known as ultramarine is the artificially prepared pigment, made by heating together china clay, soda, sulphur and charcoal. The oil fraction may contain castor oil, sulphonated castor oil, rosin oil, cotton-seed oil, sulphonated cotton-seed oil and mineral oil. The determination of the total amount of the oil present is a matter of too much difficulty to justify the time required. Determining the various constants, such as iodine number, saponification number, acid number, etc., does not give very reliable data regarding the composition.

Sympathetic Inks

The term sympathetic ink is applied to writing fluids which yield characters that remain invisible until heated or treated with some suitable reagent. Such inks appear to have been known in the early days of the

Roman Empire, for Ovid mentions milk as a suitable liquid, while Pliny refers to the juices of different plants.

In 1715 Waiz discovered the use of solutions of cobalt salts as sympathetic inks, and the French chemist Hellot also gave a description of them a few years later.

Battista Porta (1567) described various kinds of invisible inks such as, for example, a solution of iron sulphate. The writing was made visible by sponging with a decoction of galls. He also alluded to a colorless ink which was made visible by dusting the paper with a certain black powder.

Lemery (1720) described sympathetic inks which appear to consist of lead acetate, the writing being made visible by the application of a sulphide.

Examination of Documents for Invisible Writing

Apart from the application of heat and light, it is obvious that many chemical reagents must be applied to discover the presence of invisible writing. These are applied on the end of a feather to various parts of the document.

It is for obvious reasons inadvisable to describe any routine method of examination. It is quite an easy matter to ascertain whether in the case of invisible writing done with a cobalt salt the chloride or the nitrate was used. If a drop of silver nitrate is placed on one of the letters and examined under the microscope, an opalescence will gradually spread through the drop if chloride is present. Again, if a minute drop of sulphuric acid and a few particles of brucine are applied to another letter, a blood-red coloration will result if a nitrate is present.

Explosives Trades, Ltd., the Du Ponts of British Industry

THE signing of the armistice found a British corporation with vast interests devoted to munitions manufacture, like Othello, without an occupation, and and confronted with the problem of transforming their enormous plants to peace time pursuits.

Finding new fields for the capital and organizations of the Explosives Trades, Ltd., was complicated by the necessity of a system of concentration at strategic industrial centers whereby the maximum elimination of waste and removal of excessive overhead charges could be effected in the manufacture and distribution of the commodities produced.

Commissions of specialists studied industrial and investment opportunities with the result that the automobile rubber tire and accessories industry absorbed a large proportion of its capital and managerial enterprise. In addition to stock investments in the Dunlap Rubber Co. large holdings were acquired in the Tyre Investment Trust Co., which controls the Dunlap Rubber Goods Co. of Canada and the Dunlap Far East.

Explosives Trades, Ltd., also is interested in the American Dunlap Co., which is erecting a \$10,000,000 tire plant at Buffalo to be in operation early next year. In addition to the Rotax Motor Accessories Co., the bicycle trade was invaded in the purchase of John Marston, Ltd.

Following in the footsteps of the du Ponts and with the advice born of its intimate business relations with the American explosives manufactures, this English organization became partners to the extent of approxi-

mately \$25,000,000 in stock investment in the General Motors Corporation of America.

Explosives Trades, Ltd., also is substantially interested in the British Dyestuffs Corporation and the British Cellulose Co., in both of which concerns the Government also is a shareholder. Artificial leather manufacture is represented by its ownership of the British Pluviusin Co. of Manchester.

Broadly, the manufacturing activities of this war-created organization, in contradistinction to the investment, may be divided into two branches—namely, the chemical division and the mechanical division. In the first is embraced the manufacture of sporting and other ammunition, industrial explosives for gold mining, coal mining, etc., acids, chemicals, candles, gas mantles, electric bulbs, collodions, varnishes, etc. In the mechanical division is embraced the production of all kinds of metal goods and hardware, motor accessories, metal powders for welding, and ramifications therefrom.

George C. Lommel, formerly chief chemist of the Dicks-David Co., is now associated with John Campbell & Co., 75 Hudson street, New York.

* * *

C. G. Woodbury, formerly director of the Indiana Agricultural Experiment Station, is now director of a recently organized bureau of the National Canners' Association devoted to raw products research in the canning industry.

Government Research in Oil Shale Technology

THOSE of the oil-shale operators in this country who are sincerely attempting to make a real industry out of oil-shale developments, are anxious to obtain fundamental data on the retorting of oil shale, particularly as regards the effect of certain variable factors in the process of retorting on the quantity and quality of products yielded from oil shales when they are subject to destructive distillation.

From careful examination of a considerable number of suggested processes for treating oil shales and the conflicting ideas on which they are designed, it seems that accurate information of a fundamental nature is highly essential to the successful establishment of an oil shale industry in this country.

Accordingly, the United States Bureau of Mines, in co-operation with the State of Colorado, is undertaking to furnish some definite and impartial information of this type through investigations now under way at the University of Colorado, Boulder, Colo. This work is being conducted by Martin J. Gavin, refining engineer of the Bureau of Mines, and Leslie H. Sharp, chemical engineer for the State of Colorado.

Object of the Research

The purpose of the investigation is to determine with scientific accuracy the conditions of retorting oil shale to produce the highest yield of the best products.

It is realized that these conditions when so determined may not be applicable in their entirety to large scale retorting operations, but the work should indicate what the best conditions actually are, and these can be applied to large scale work in so far as practical commercial consideration permit. If fundamental work on oil shale retorting is to be done at all, it must be conducted on such a scale and in such apparatus and equipment as will enable conditions to be regulated at will and controlled accurately otherwise the results will be of little value.

Research Equipment

A retort for the distillation of oil from oil shale has been designed and installed, together with the necessary auxiliary equipment for controlling and determining variable factors of distillation, and for recovering and determining the quantity and quality of the products yielded from the shales.

The retort is of such a nature that conditions of retorting can be accurately and completely controlled, and varied at will. It is not designed as a commercial retort, but only for research purposes. A testing laboratory with equipment necessary for the examination of the shales, physically and chemically, and the products yielded by them, also has been fitted up. The apparatus being used has been designed especially for the work by Messrs. Gavin and Sharp, with the assistance of L. C. Karrick, junior refinery engineer of the Bureau of Mines, and after consultation with many engineers interested in and, in many cases, working on oil shale.

The retort proper is a cast-iron, externally heated, horizontal, rotary, cylindrical retort, designed to insure even distribution of the heat through the shale charge during treatment. Its capacity is approximately 75 pounds of shale at a charge. The retort is gas fired. Stuffing boxes, designed to function without leaking at high temperatures, enable stationary inlet pipes and outlet pipes to be connected to the retort. The inlet pipe carries the pyrometer and per-

mits the introduction of steam or various gases. The outlet pipe leads to a two-stage condenser, the first stage being cooled by air or hot water and the second by cold water.

From the condenser the gases are forced through oil and water scrubbers by a small rotary pump. The oil scrubber is for removing any uncondensed light oils, and the water scrubber for removing ammonia from the uncondensed gases. Manometers at various points permit the regulation of pressure in the retort and in the condensing and scrubbing system. The pyrometer system also is so equipped that an automatic temperature control can be used if this seems desirable.

The ends of the retort are well insulated and the whole set in a fire-brick furnace, from which it may be removed easily. The retort is rotated by a 5-horse power electric motor through a belt and worm gear drive.

Material Used

The material used in the investigations is oil shale obtained from the DeBeque, Colo., shale field. It yields, on distillation in the Bureau of Mines testing apparatus, about 42 gallons of oil to the ton, and is therefore a fairly representative sample of the shales that probably will be first worked in Colorado. The shale used will be as uniform as possible in character and oil yield, and will all be obtained from the same seam at the same point, in order to avoid the introduction of unnecessary variable factors in the tests and to render results strictly comparable.

Problems to Be Solved

Effort will be made, so far as the equipment and capital at hand make possible, to determine the effect of the following variable factors in retorting on the quality and quantity of the products produced from this shale:

1. The rate of heating to a definite final temperature.
2. Thickness of the shale layer in the retort
3. Size of individual particles of shale.
4. Vacuum or reduced pressure.
5. Various pressures above atmospheric.
6. Steam atmosphere at various pressures and temperatures.
7. Other atmospheres, such as carbon dioxide, carbon monoxide, hydrogen, illuminating gas, etc.
8. Actual temperature reached.

In each case the rate of formation of products and the total time necessary to bring the retorting process to completion will be determined.

It is doubtful whether all these determinations can be made satisfactorily with the limited personnel and equipment available for the year, but it is hoped that sufficient valuable data may be obtained to be a real contribution to the present knowledge regarding oil shales and to justify a continuation and expansion of the work. As far as possible the effect of each variable will be taken up by itself, and thoroughly studied before passing on to another.

Results Expected

Carefully conducted work along the lines above indicated should be of value in giving information on the following points:

1. Are oils of different qualities formed from shales

consecutively as their boiling points are reached, the so-called "fractional education theory," or does the shale yield a single, more or less uniform crude oil throughout the course of the distillation?

2. If the fractionation above mentioned takes place, to what extent does it progress and hence to what extent may economies be introduced in refining shale oils, if the various fractions are directly recoverable from the retort?

3. The time necessary at a given temperature to effect complete distillation of the shale and the quantity and quality of products so produced.

4. The effect of steam and other atmospheres in retorting—

a. In forming undesirable emulsions with the oils;
b. In preventing the formation of undesirable hydrocarbons, such as olefins, diolefins and acetylenes in the oils;

c. On the recovery of the nitrogen of the shales as ammonia or other nitrogen containing compounds;

d. On the combustion or utilization of the carbon remaining after the oil has been distilled, to provide combustible gas for retorting;

e. On quality and quantity of gas formed;

f. On heating efficiency of the retort;

g. On capacity of the retort, that is, time of completed distillation under most favorable conditions.

5. What is the most favorable size of shale to retort?

6. What quality and quantity of finished products may be expected from shale oil?

7. How are the nitrogen and sulphur of the shale distributed in the products, and how may they best be removed or prevented from forming?

8. Physical and chemical constants of the shale and products, particularly those of value in the design and operation of commercial plants, will also be determined. Work is under way on the determination of specific gravity, weight per unit volume when crushed to different sizes, heat of combustion, specific heat, heat of conductivity and chemical analysis of the shale, and specific and latent heats of the crude oil and its various distillation products.

Suggestions Solicited

It is felt that the work is almost to be considered pioneer work in the scientific investigation of oil shales. A material is being dealt with regarding which little is known, both as to methods of treatment and its products. For these reasons the Bureau of Mines invites suggestions or criticism of a constructive nature as to the conduct of the work. It is hoped that results can be presented to the public as rapidly as obtained through the various trade journals. The complete work is to be the subject of a bulletin of the Bureau of Mines.

Corn Products Refining Co.

In his report of the six months (ended June 30, 1920), operations of the Corn Products Refining Co., president, E. C. Bedford, belittles, in the absence of surplus production, the fear of business depression, but expects some recession in commodity prices as production catches up with the demand.

He says the company should have a grinding capacity between 155,000 and 160,000 bushels of corn daily early next year. At that time the new plant, which it is proposed to erect in the vicinity of St. Joseph, Mo., Omaha, Neb., or Kansas City, Mo., ought to be completed and in operation.

The company will lose a daily grind of about 50,000 bushels this year, due to the fact that several plants have been sold in accordance with the decree of the U. S. Court in the dissolution suit. But the new plant and increased capacity at the Argo, Ill., refinery will make up for this falling off.

The new pier which the company is building at Edgewater, N. J., and costing about \$2,500,000, is expected to be finished in September. The wharf, which will be 110 feet long, will have a two-story building thereon, in which it is expected that 1,000,000 cases of syrup will be packed yearly. Aside from receiving shipments of Argentine corn, the new wharf will be used for canning, packing and storage purposes.

At the present time all the plants of the company are operating at between 85 and 90 per cent. of capacity. Corn syrup is selling at about 12 cents a pound under the price of sugar, hence the big demand for the company's products. The plant of the National Starch Co., which the U. S. Court ordered to be sold before the end of 1920, has not yet been disposed of, but it is expected that the company will obtain an extension of time in which to consummate the sale.

Business of the company for the six months ended June 30, 1920, yielded a surplus, after charges, Federal taxes and preferred dividends, of \$8,360,962, equal to \$16.79 a share earned on the \$49,784,000 common

stock, as compared with surplus of \$5,987,814, or \$12.03 a share in the corresponding period of 1919.

The following table shows per share earnings on the common stock since 1912:

*1920	\$16.79	1916	.....	\$8.03	
1919	.....	23.36	1915	.....	2.17
1918	.....	13.19	1914	.....	.41
1917	.....	18.60	1913	.....	.37

*Six months.

Present Conditions in Scotch Oil Shale Industry

The general trend of the oil industry during 1919 closely resembled that of 1918. Like that year, the products of this enterprise were in constant high demand, and correspondingly high prices were dominant, owing to the high cost of production. The year started with a tremendous demand for oils and gasoline, still occasioned by war requirements, and it is estimated that wages advanced in this industry 20 per cent. over those of 1918.

The organization of the Scottish oil companies formed two years ago to meet foreign competition continued to bring good results and seems permanent. At the present time all these companies are absorbed by the Anglo-Persian Oil Co. Wages have in all cases reached an unprecedented level, which adds a touch of uncertainty in the present year. During 1918 considerable interest was shown in proposals to drill for petroleum, as the estimated resources of Scotland's oil-shale fields were given as sufficient to maintain the present output for 100 years. Drilling was accordingly carried on throughout 1919, but nothing was discovered to warrant much enthusiasm. Drilling is still going on in the Lothian Fields, but with no apparent success. The average yield in 1919 is the same as for 1918, namely, 1 ton of oil shale producing about 22 gallons of oil and 45 pounds of sulphate of ammonia.

Manufacture of Sulphuric Acid by the Chamber Process

By M. Kaltenbach

ALTHOUGH the chamber process of making sulphuric acid has been in use for over a century; although the literature of the process is very voluminous and although many patents have been issued on improvements made to the secondary parts of the apparatus, such as pumps, mechanical furnaces, etc., nevertheless no real effort has been made to remedy the inherent primary defects of the process. In spite of the advantages of the comparatively new contact process of making sulphuric acid, the chamber plants have regularly increased in number and the question of overcoming the disadvantages of the chamber process is of as much interest as ever.*

The defects of the process are well known and need not be discussed here in detail. The great amount of room taken by the chambers, the weight of the lead, the difficulties of regulation, of operation and of repairing the apparatus and the small capacity of such a large installation have been the subject of much study.

During the war, the writer had the occasion to design, construct and supervise a very important chamber plant, consisting of 6 units, each capable of producing 60 to 65 tons of 53° Bé acid daily; and in the course of his work, he had the opportunity of making some observations, which may perhaps be of interest to acid makers and which has led him to make certain suggestions regarding the modification of the process which it is hoped will turn the manufacture of sulphuric acid to an entirely new path.

The sulphuric acid has been made of studying the problem from the purely chemical viewpoint, although there are many physical and physico-chemical principles involved. The writer has studied the process from the latter viewpoint.

The following discussion is divided into four parts: I, description of process used; II, tabulation of statistics on production, temperatures, yields, consumption of raw materials; III, analysis of these figures by striking thermal balances; IV, conclusions derived from the study of these facts and the modifications that suggested themselves as a result and that would tend to remove the defects of the process.

I. Principal Characteristics of the Systems Under Observation

After considerable deliberation it was thought best to design the chambers so as to produce 5 to 5.005 kg. of sulphuric acid for each cu. m. of volume. Each system had a cubical content of 7,800 cu. m., divided into four chambers of equal size. The chambers were each 5 to 5.5 m. wide, 29 m. long and 13 m. high to the top of the arched ceiling.

The furnaces used were of the helicoidal type (Bracq-Laurent). The amount of dust produced was at a minimum with these furnaces and permitted the increase of the temperature of the gases, entering the Glover tower, to 500° C.

The Glover towers were 4.05 m. in exterior diameter and 10.05 m. high. The Gay-Lussac towers were

4.035 m. in diameter and 12.065 m. high. They were arranged in series with an intermediate fan.

The ceilings and screens of the chambers were suspended from the supporting framework by means of metal fasteners, according to the Moritz system. The ceiling was arched and the chamber basins were formed from sheet iron, reinforced with angle irons and covered with lead. The auxiliary apparatus, such as pumps, tanks, coolers, etc., were placed in the same house as the chambers.

All acid movements were made by means of pumps (centrifugal cast-iron type), which gave perfect satisfaction. The atomizers were made of steatite, instead of the costly platinum.

II. Results of Manufacture

Below are given the actual results obtained in the use of this apparatus during several consecutive months in 1918.

(1) FURNACES.—(a) Roasted pyrites: 31 tons desulphurized from 48 per cent. to 1.8 per cent. and containing in the crude state 2 per cent. moisture.

(b) Concentration of SO_2 gas: 8 per cent.

(c) Total volume of gas: 125,000 cu. m. at 0° C and 760 mm. of which 10,000 cu. m. were SO_2 .

(2) GLOVER TOWERS.—(a) Nitrogen flow: 180 tons of 77 per cent. H_2SO_4 , containing 15 gms. of N_2O_5 per liter.

(b) Flow of acid from chambers: 54 tons of 64 per cent H_2SO_4 (the total production of the chambers).

(c) Flow of nitric acid of 52.8 per cent. HNO_3 , 0.75 kg. of 36 per cent acid for every 100 kg. of sulphuric acid of 64 per cent.

(a) Temperatures: Irrigating acid, 25° C; gas at entrance, 450° C; gas at exit, 91° C; hot acid leaving, 131° C.

(f) Production of Glover acid was 1-6 of the total production of the system, i.e., 6,540 kg. H_2SO_4 =8,500 kg. 77 per cent. acid.

(3) CHAMBERS.—(a) Volume of each chamber, 1,950 cu. m.

(b) Surface of the chamber basins, 202 sq. m.

(c) Surface of the chambers (screens and ceilings), 937.5 sq. m.

(d) Average temperatures of the four chambers: 93°; 86°; 67°; 44°. Average temperature of the surrounding air, 8° C. Average difference from surrounding temperature: 85°; 78°; 59°; 36°. Temperature of the acid in the chamber basins: 62°; 59°; 44°; 31°.

(e) Production of the chambers: 3-5 for the chamber groups I and II, i.e., 20.7 tons of H_2SO_4 =32.4 tons 64 per cent. acid; 2-5 for the chamber groups III and IV, i.e., 13.76 tons of H_2SO_4 =21.6 tons 64 per cent. acid. Total for the four chambers, 34.46 tons H_2SO_4 =54 tons of 64 per cent. acid.

*Abstracted from *Chimie et Industrie*, Vol. 4, 1920, by Ismar Ginsberg, Aetna Explosives Co., New York.

The total production of the system was, therefore, 34.46 tons plus 6.54 tons, i.e., 41 tons sulphuric acid obtained altogether in the form of 77 per cent. Glover acid or 53.25 tons of solution.

(4) GAY-LUSSAC.—Total irrigating acid 178,004 tons 77 per cent. sulphuric acid leaving the tower with an average content of 15 gms. of N_2O_5 per liter, containing in all $180 \times 15 \div 1.7 = 1,590$ kg. N_2O_5 .

(5) YIELD.—207 per cent. 64 per cent. acid (figured on the pyrite used). The acid of the chambers was withdrawn from the first chamber in units I and II, and from the third chamber in units III and IV and then charged to the Glover, from which the total acid produced was recovered in the form of 77 per cent. acid. Production per cubic meter of each chamber was 5.025 kg. H_2SO_4 ; per square meter of chamber surface was 10.009 kg. H_2SO_4 .

* * *

III. Thermal Balances

In order to correlate the actual operating data there will be established, as given below, the thermal balances of the Glover tower and the chambers and that of the entire system for both groups, one comprising units I and II and the other units III and IV.

(1) Glover Tower.

THE CALORIES ENTERING THE TOWER COMPRISE:

(a) The heat in the roasted gases, consisting of water vapor, SO_2 , N and O.
Water vapor — 2% of 31 tons of pyrites = 620 kg.
8 gms. H_2O per cu. m. in 115,000 m. of gas = 920 kg.

Total = 1,540 kg.

Water vapor—1,540 kg. at $450^\circ C$.

Total heat 809 calories . . . = 1,235,000 cal.

SO_2 — 10,000 cu. m. at $450^\circ C$.

Specific heat, 0.43 = 1,930,000 cal.

N + O — 115,000 cu. m. at $450^\circ C$.

Specific heat, 0.30 = 15,500,000 cal.

Total = 18,665,000 cal.

(b) Heat carried away by the circulating acid:

180 tons nitrous acid (77%) at $25^\circ C$.

54 tons chamber acid (64%) at $25^\circ C$.

Total = 234 tons acid of average concentration, 77%

Specific heat, 0.45 = 2,570,000 cal.

480 kg. of HNO_3 at $15^\circ C$. . . = 20,000 cal.

2,590,000 cal.

(c) Heat of formation of 77% acid in the Glover tower:

6,540 kg. $\times$ 61.9 cal. = 4,110,000 cal.

0.098

Total heat entering Glover tower . 25,365,000 cal.

THE CALORIES LEAVING THE TOWER COMPRISE:

(a) Heat of vaporization of water due to the concentration which takes place in the Glover tower. It is first necessary to determine the quantity of water that is really evaporated. That is easy, for we have all the necessary data.

Chamber acid: 54 tons of 64% coming from the 77% Glover acid and introduced in the tower

9,100 kg. H_2O

Nitric acid 200 kg. H_2O
Pyrites (2% of 31 tons) . . . 620 " "
Moisture in the air (8 gms. per cu. m. in 115,000 cu. m.) 920 " "
10,840 " "

From this it is necessary to subtract the water required for the production of acid in the Glover tower: 6,540 kg.

18
 H_2SO_4 , corresponding to $6,540 \times \frac{18}{98} = 1,200$ " "

plus the water of dilution to give a

6,540
77% Solution = $\frac{6,540}{0.77} = 1,960$

making a total of

3,160
subtracted from 10,840 kg. H_2O

leaves the total quantity of water

evaporated 7,680 kg.

The total heat of vaporization of that water at $91^\circ C$. will then be $7,680 \times 634$ calories = 4,860,000 calories.

(b) Specific heat of gases leaving.

These gases consist of:

(1) 115,000 cu. m. of N + O, from which there must be subtracted the quantity of O absorbed in the formation of Glover acid, that is:

16 1065
 $6,540 \times \frac{16}{98} = 1,065$ kg. = $\frac{1065}{1.43} = 745$ cu. m.

of oxygen, leaving 114,255 cu. m.

(2) 10,000 cu. m. of SO_2 , less the quantity of O:

64 4260
 $6,540 \times \frac{64}{98} = 4,260$ kg. = $\frac{4260}{2.87} = 1,480$ cu. m.

leaving 8,520 cu. m.

(that is, a total of $745 + 1,480 = 2,225$ cu. m.) leaving a total of 122,775 cu. m.

The calories carried away are then:

$114,255 \times 0.3 \times 91 = 3,120,000$

$8,520 \times 0.3 \times 91 = 334,000$

3,454,000 cal.

(c) The heat of concentrating 54 tons of chamber acid blowing down the Glover tower from 64 to 77 per cent. This heat is the inverse of the heat of dilution and corresponds to 3.2 calories per molecule, or a total of

34,460
 $\frac{34,460}{0.098} \times 3.2 = 1,125,000$ cal.

(d) The heat carried away by the hot 77% acid flowing from the Glover tower at $131^\circ C$. The weight of the acid consists of the following:

180 tons. Nitrous acid—1,590 kg. of nitrous vapors evolved = 178,410 kg.
54 tons. 64% chamber acid concentrated to 77% or 54×64

77 = 44,750 "

6,540 kg. of acid produced or $\frac{6,540}{0.77} = 8,500$ "

Total 231,660 kg
which contain $231,660 \times 131 \times 0.45 = 13,650,000$ cal

THERMAL BALANCE OF THE GLOVER TOWER. RE-CAPITULATION.

Input.	
(a) Heat of gases.....	18,650,000 cal.
(b) Heat of the irrigating acids.....	2,590,000 "
(c) Heat of formation.....	4,110,000 "
Total	23,465,000 cal.
Output.	
(a) Heat of vaporization.....	4,860,000 cal.
(b) Heat in outgoing gases.....	3,454,000 "
(c) Heat of concentration.....	1,125,000 "
(c) Heat of hot acids.....	13,659,000 "
	23,089,000 cal.
Difference (radiation)	2,276,000 "
	25,365,000 cal.

ciliation of the figures which enables the satisfactory explanation of the difference which arises in the balance sheet, drawn up from the calculations that follow:

Chambers

The chambers in the group, composed of units I and II are first examined.

The heat entering is made up of:

- The heat of the gases coming from the Glover tower (see above) 3,454,000 calories.
- The heat of the condensation of the water vapor (see above) 4,860,000 calories.
- The heat in the water itself which is atomized into the chambers. To establish this factor, the weight of the water must be found beforehand. In the absence of exact data on the content of the gases, coming out of the first group, in water, we are justified in assuming that this is not very high. Furthermore,

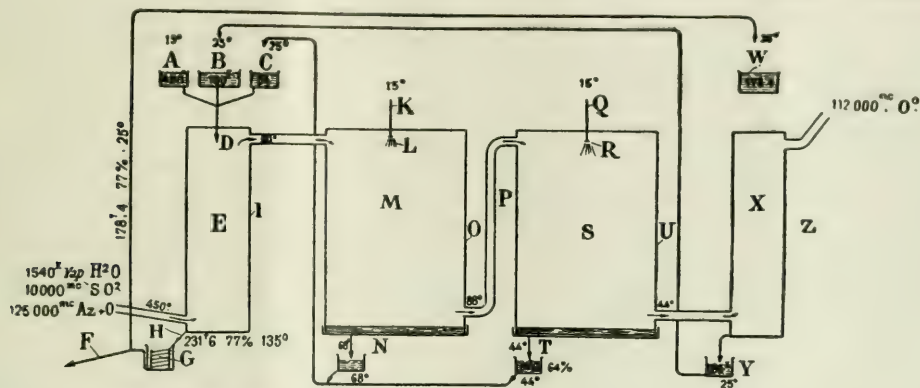


Fig. 1. Diagram of the Flow of Acids, Etc., and of the Thermal Equilibrium of the Acid-Making Process.

- | | | |
|---|--|--|
| A. Nitric acid, 36%. | J. Heat in gases, 8,314,000 cal. | R. Water, 117,500 cal. |
| B. Acid containing 77% nitrous products. | K. Atomized water, 7,820 kg. | S. Chamber group III-IV. |
| C. Chamber acid, 64%. | L. Water, 117,000 cal. | Production = 34% (13.76 tons H_2SO_4 = 21.6 tons, 64% acid); heat of formation, 8,960,000 cal.; average temperature, 55.5° C.; heat in gases, 3,021,000 cal. |
| D. Heat in liquids, 2,590,000 cal. | M. Chamber group I-II. | T. Heat in acids, 466,000 cal. |
| E. Glover tower. | Production = 66% (27.7 tons H_2SO_4 = 22.4 tons, 64% acid); heat of formation, 13,500,000 cal.; average temperature, 89.5° C.; heat in gases, 8,314,000 cal. | U. Radiation, 10,112,500 cal. |
| Production = 16% (6,540 kg. H_2SO_4 = 8,500 kg, 77% acid); heat of formation, 4,110,000 cal; heat in gases, 13,655,000 cal. | N. Heat in acids, 1,080,000 cal. | V. Heat in gases, 1,520,000 cal. |
| F. Production, 50.25 tons, 77% acid. | O. Radiation, 17,830,000 cal. | W. Glover acid. |
| G. Cooler, 11,000,000 cal. | P. Heat in gases, 3,021,000 cal. | X. Gay-Lussac Tower. |
| H. Heat in acids, 13,650,000 cal. | Q. Atomized water, 7,840 kg. | Y. Nitro-sulphuric acid, 77%. |
| I. Radiation, 2,276,000 cal. | | Z. Surrounding air temperature, 8° C. |

A small part of the difference between the heat entering and leaving the system is due to unimportant omissions in the calculations, shown above, such as, the heat of vaporization of nitric acid, that of the nitrous products and that of the small quantity of H_2SO_4 carried out to the chambers in the Glover gases. The exterior surface of the Glover tower is 188 sq. m. and the average temperature difference between the interior and exterior is about 100°C. A coefficient of heat transmission of 5 is assumed in order to account for the lost heat, as

$$K = \frac{2,276,000}{24 \times 100 \times 188} = 5$$

At the end of this study, it will be seen that the coefficient 5 is exactly what follows from the thermal balance sheet of the chambers when the heat transmission ability of the walls is determined. The conditions of heat transmission are in that case, it is true, somewhat different, but there is nevertheless a recon-

the question is not very important, as it has an effect only on the divisions of the water between the two groups of chambers and not on the total quantity injected. It also is known that the quantity of water vapor in the gases, entering the Gay-Lussac tower is negligible. The production of this group of chambers was 34.4 tons of 64% acid necessitating:

$$\begin{aligned} \text{Water of formation } 20,700 \times \frac{18}{98} &= 3,800 \text{ kg.} \\ \text{Water of dilution } \frac{20,000}{0.64} - 20,000 &= 11,700 \text{ "} \\ \text{Total} &= 15,500 \text{ kg.} \end{aligned}$$

As the water vapor, which comes from the Glover tower is 7,680 kg., there must be introduced into the chambers atomized water, weighing (15,500—7,680) 7,820 kg.

This quantity of water, being at 15°C, the calories

entering the chambers are $7,820 \times 15$ or 117,000 calories.

(d) The heat of formation of 64% acid or 63.9 calories per gram molecule:

$$\frac{20,700 \times 63.9}{98} = 13,500,000 \text{ calories.}$$

THE HEAT LEAVING THE SYSTEM COMPRISES:

(a) The heat of the outgoing gases. These gases are composed of the 114,255 cu. meters of N and O brought into the chambers, from which there must be subtracted the volume of oxygen absorbed by the formation of 20,700 kg. of H_2SO_4 or

$$\frac{20,700 \times 16}{98} = 3,390 \text{ kg.}$$

$$\frac{3,390}{1.43} = 2,320 \text{ cu. meters} \quad 2,320 \text{ cu. m.}$$

The volume remaining is hence..... 111,885 cu. m.
Then from 8,520 cu. m. of SO_2 less

$$\frac{64}{98} \times 20,700 \times \text{or } 13,500 \text{ kg., equivalent}$$

to 4,700 cu. m., we have..... 3,820 cu. m.

Total 115,705 cu. m.

These gases leave at a temperature of $86^\circ C$.

$$111,885 \times 86 \times 0.3 = 2,880,000 \text{ cal.}$$

$$3,820 \times 86 \times 0.43 = 1,410,000 \text{ "}$$

$$\text{Total } 3,021,000 \text{ cal.}$$

(b) The heat in the outgoing acids. There is drawn from the first chamber at $68^\circ C$ just the quantity of acid, corresponding to the production of the two chambers I and II, or

$$32,004 \text{ tons} \times 68^\circ \times 0.49 = 1,080,000 \text{ calories.}$$

THERMAL BALANCE OF CHAMBERS I AND II. RECAPITULATION.

Input.

(a) Heat in gases.....	3,454,000 cal.
(b) Heat of condensation of water vapor	4,860,000 "
(c) Heat in the atomized water.....	117,000 "
(d) Heat of formation.....	13,500,000 "
Total	21,931,000 cal.

Output.

(a) Heat in gases	3,021,000 cal.
(b) Heat in acids	1,080,000 "
Total	4,101,000 cal.
Remainder lost in radiation.....	17,830,000 "
Total	21,931,000 cal.

CHAMBER GROUPS III AND IV.

It is unnecessary to give the details of the calculation as they are identical with those of the first group and the balance sheet is accordingly given below in its summarized form:

Input of Heat.

(a) Heat in gases.....	3,021,000 cal.
(b) Heat of condensation of water vapor	nothing
(c) Heat of the atomized water $7,840 \times 15$	117,000 "
	$13,760 \times 63.9$
(d) Heat of formation	8,960,000 "
	0.098

Total 12,098,500 cal.

Output of Heat.

(a) Heat in gases at $44^\circ C$	1,520,000 cal.
(b) Heat in outgoing acids 21,006 tons at $44^\circ C$	466,000 "
Loss in radiation	10,112,000 "

Total 12,098,500 cal.

The sole difference, existing between the two groups, is that in the second it is not necessary to take into account the large quantity of water that the Glover tower sends to the first group.

ANALYSIS OF THE THERMAL BALANCE SHEETS.

Glover Tower

The heat in the gases and irrigating acids, 21,255,000 cal., supplied the heat in the outgoing gases and acids and counterbalanced the radiation loss, 19,380,000 cal. The heat, required to evaporate the water in the concentration process taking place in the tower, was supplied by the heat of formation of acid; that is, of the 5,985,000 cal. required for the former process, 4,110,000 cal. came from the latter.

16% of the total acid production takes place in the tower. This cannot be produced in the lower part where the temperature of the acid is $130^\circ C$ and that of the gases $450^\circ C$ and where almost all of the nitrous products previously have been eliminated. Neither is it likely that the production of acid can occur to any great extent in the part of the tower above the packing. Consequently the zone of maximum production is very limited and possesses a temperature between 100 and $110^\circ C$. The cubic contents of this zone can scarcely be greater than 25 cu. m. which means that the production per cu. m. exceeds 250 kg. of H_2SO_4 . Where the nitrous products are lacking, as in the lower part of the apparatus, the acid formation process gives way to that of acid concentration.

The reason for this localization of the formation of acid in the tower is seen in the fact that the catalytic production of H_2SO_4 from SO_2 in the presence of the nitrous catalysts is an exothermic reaction which reaches an equilibrium at any given temperature, which temperature is caused to change by the heat evolved by the reaction, resulting in a disturbance of the equilibrium. The factors which determine the latter are the concentrations of (1) the sulphur dioxide gas, SO_2 ; (2) the nitrous products, N_2O_3 ; and (3) the

sulphuric acid, $\frac{H_2SO_4}{H_2SO_4 + H_2O}$ in the liquid and gaseous phases.

At the base of the tower, for example, where the temperature is $131^\circ C$, the conditions of equilibrium

give an H_2SO_4 concentration in the liquid phase of about 77%. The N_2O_5 and SO_2 concentrations in the liquid phase are practically nil. In the gaseous phase, the excess of H_2O , N_2O_5 and SO_2 all escape and the Glover tower concentrates only.

The most favorable conditions for acid formation are found higher up in the tower. We made at this point a very important observation which is corroborated by the thermal balance sheet, viz., that the reaction, although it is exothermic, cannot raise the temperature of the zone, which is best suited for the formation of H_2SO_4 , because the evolved heat is immediately dissipated in vaporization of water. The equilibrium conditions demand that the acid concentration at this point shall be greater than that of the irrigating acid, and consequently the excess water is evolved in the gaseous form. Therefore, in order to have the Glover tower produce, it must contain a zone, within which the following three conditions exist at one and the same time: A fixed temperature; a fixed concentration; and as a result of the first two conditions, the presence of an excess of water whose evaporation absorbs the heat produced in the reaction.

The zone of most favorable formation temperature moves up and down the tower as the concentration increases or decreases.

The Glover tower, receiving a sufficient volume of well-diluted hot gases, which are irrigated simply with 77% acid, does not possess favorable conditions for the formation of acid, because the zone of most favorable temperature would mount too high up in the tower. The temperature at each point would adjust itself to the conditions of acid concentration, but that temperature would in this case be higher than the optimum temperature. Production of acid would be diverted to the chambers where conditions are different and the concentrating effect of the tower would be augmented.

The Glover tower, receiving an insufficient supply of hot gases to allow concentration to 53° Bé acid to take place, but just sufficient to denitrate the Gay-Lussac acid, bringing its temperature up to about 130°C, also would not produce acid. The temperature would decrease regularly from the bottom up, but at the point where the most favorable temperature is found there would not be the required most favorable concentration or consequently the necessary water vapor.

When the Glover tower is irrigated with too dilute an acid, the zone of maximum production descends and the temperature at the base of the tower becomes too low to effect complete denitration of the nitrosulphuric acid.

The Chambers

In the chambers the temperature generally varies between 100° and 45°C. In contradistinction to what takes place in the Glover tower, it is no longer possible here to dissipate the heat of reaction by vaporization of water and maintain thereby a constant temperature. On the contrary, there is not enough water present and more must be added. Auto-regulation of temperature no longer takes place. The heat of reaction tends to elevate the temperature considerably and this effect is neutralized by giving the chambers as large a cooling surface as possible.

Furthermore, the cooling occurs at some distance from the place where the heat is evolved, which is again different from what happens in the Glover tower. Accordingly there are various local differences in the temperature of the chambers, which result in the

more or less haphazard movement of the gases, which is altogether impossible to control. The essential conditions of maximum production, the maintenance of the temperature at the most favorable point and the intimate contact of gases and liquids no longer apply. A stronger cooling effect of the walls is not, in our opinion, the place to look to for the correction of the essential defects of the apparatus.

The further along the gases move through the successive chambers, the more the quantity of SO_2 , capable of reacting, decreases and the lower the temperature becomes, while the same quantity of heat is applied to a volume of gas that does not vary, the further away we move from the most favorable reaction temperature. While in the first chamber, there existed the disadvantage of too high a temperature, in the following chambers the contrary was true. The use of large volumes and great surfaces does not permit the correction of this fault.

In addition, the proper admixture and contact between the reacting gases is not assured under the conditions existing in the chambers. The atomized water is injected through certain locations in the ceiling; the gases circulate through the chambers in paths of their own, indeterminate and affected undoubtedly by the local variations in temperature, due to formation of drops of acid; the acid liquids in the chamber basins, whose vapor tension constitutes one of the factors in the equilibrium, are far removed from the greatest part of the gaseous molecules.

Certain experiments were made to determine the influence exerted by the vapor tension of the acid in the chambers on the production of the acid itself. This was done by introducing increasing quantities of dilute sulphuric acid (20° Bé) into the first chamber. The weights of dilute acid may be gradually increased to about 10 tons per day, reducing at the same time the quantity of atomized water injected, without either the production nor the concentration of the acid being affected. This cannot happen unless the excess water in the chamber basins passes very rapidly into the gaseous phase.

It is, however, known that the influence of the vapor tension of the acid in the bottom of the chamber is much diminished in chambers of great height (20 m.). Such chambers have but little acid in the basins and this acid cools rapidly. The vapor tension is quickly reduced to such a point that the nitrous products tend to pass into the liquid phase. The effect of the temperature of the chamber acid on the equilibrium generally has not been considered of any importance in the past, but it is one of the factors which exert a considerable influence on the efficiency of the process.

A closer examination of the thermal balance sheet of chambers I and II will show some very interesting and important facts. The heat in the incoming and outgoing gases is almost the same. The two important factors are the heat evolved by the condensation of the water vapor and the heat of formation of H_2SO_4 . This heat must be removed by radiation through the chamber walls.

The cooling effect of the chamber walls at the bottom where the acid collects is very small and is evidenced in the reduction of the temperature of the condensed acid from 89.5°C (the formation temperature) to 68°C (the temperature of the outflowing acid). This is equivalent to 342,000 cal. only [32,004 tons $\times 0.49 \times (89.5 - 68)$] for 404 sq. m. of wall surface, or 850 cal. per 24 hours, or 35.5 cal. per hour per sq. m. In the second group of chambers (III and IV) only 124,000 cal. are eliminated in this way.

The total number of calories to be radiated by the rest of the chamber is, in the first group, 17,480,000 calories and in the second group, 9,988,500 calories. The coefficient of heat transmission K is 4.86 for the former and 4.63 for the latter.

The production capacity of the chambers is directly proportional to the difference between the interior and exterior temperatures. The radiation effect of the chamber walls becomes less and less effective as one approaches the Gay-Lussac end of the apparatus.

IV.—Conclusion—Defects of Chamber Process

The defects of the chamber process arise from the impossibility of regulating the reaction temperature in order to obtain a condition as near as possible to the most favorable temperature; the unsatisfactory contact between the reacting gases and liquids; the very inefficient radiation of the lead surfaces whose heat transmission coefficient is hardly 5 cal. per sq. m. per hour per degree difference in temperature; and the exceedingly bulky and very costly construction.

Elimination of Defects of Chamber Process

To correct these faults, a process has been devised and recently patented by the author. Its main characteristics are:

(1) The dissipation of the evolved heat in the immediate vicinity of its generation.

(2) The possibility of regulating both the temperature and the concentration at one and the same time in the reaction zones so that the most favorable conditions are obtained.

(3) Contact between the reacting gases and liquids in as intimate a manner as possible.

System of Pipes

The apparatus, in which it is intended to secure these results, consists of a system of pipes, composed of tubes of small diameter, which are provided in the interior with an efficient packing. On the exterior, these tubes are surrounded by a jacket, through which water is circulated, the flow of which is regulated at will so as to maintain any desired temperature in the interior of the tubes.

The gases leaving the Glover tower travel through the tubes of the successive systems, while the liquids, mixed with the quantity of water necessary for the reaction, circulate through the apparatus in the opposite direction. The gases are fed to the tubes through a common header so that they pursue parallel paths through the apparatus. Certain suitable devices assure the regular distribution of the gases and liquids in these tubes.

The dimensions and the shape of the transverse section of each tube have been very carefully designed so that the efficacy of the water jacket may easily be felt at the center as well as at the walls of the tubes. The number of the tubes depends on the volume of the gases to be treated and is calculated as a function of the available driving pressure. The length of the tubes depends on the surface required to assure the transmission of the heat that is evolved in such a manner that the difference in temperature is divided equally between the two circulations.

The advantages claimed for this process are as follows:

(1) Great ease of controlling and regulating the reaction temperature. This is accomplished by the circulation of water in the exterior jacket and by the circulation of acid through the interior of the tubes.

(2) Effective utilization of the surface of the tubes for the interchange of heat, that interchange taking

place between two liquids circulating countercurrently. The number of calories per sq. meter of surface per degree difference in temperature per hour is in the neighborhood of 100 instead of 4-5 in the case of the chambers.

(3) Considerable reduction in the amount of lead used, as well as in the structural work (chamber walls, supports, etc.), effecting thereby a very considerable saving in the cost of installation.

(4) Ability to isolate one or more tubes of a system for the purpose of cleaning or repairing without interfering with the operation of the apparatus.

(5) Possibility of using just the requisite number of tubes, according to the quantity of pyrites roasted.

(6) Complete independence of atmospheric conditions.

(7) Greater facility of obtaining the entire production in the form of 60° Bé acid, by making use of the heat generated in the reaction.

(8) Elimination of water-atomizing apparatus.

Description of the System

In figure 2, which is a diagrammatic representation of this apparatus for making sulphuric acid, 1 is the Glover tower which receives through the pipe 2 the hot gases coming from the furnaces and which discharges these gases through pipe 3 into the first piping system 4, which is made up of a number of tubes, all constructed alike, provided with interior packing of uniform resistance 5, and surrounded by a water jacket 6. The circulation of the water can be regulated by means of the admission valve 7. Each tube can be isolated from the rest of the apparatus by means of the dampers 8 and 9. The gases then pass through the rest of the tubes 10 which are constructed in a similar fashion, and finally through the Gay-Lussac tower 11, which may itself constitute the last pipe system of the series, the only difference being that the temperature is maintained therein at as low a point as possible.

The nitro-sulphuric acid (60° Bé) recovered from the Gay-Lussac tower in the reservoir 12, is raised by means of the pump 13 to the supply tank 14 which feeds the Glover tower. The acid which comes from the tower and is collected in the tank 15, after having first passed through the cooler 16, is partly returned to the Gay-Lussac feed tank 18 by means of pump 17. The surplus acid is removed through the pipe 19 and forms part of the production.

The pipe systems 4 and 10 are supplied with acid by means of the feed tanks 20, which may receive a regulated quantity of acid through the piping arrangement 21, which conveys the acid recovered in the corresponding system of tubes. The acid is collected in the reservoir 22, and is elevated by the corresponding pump 23 (1) through the pipes 24, connected to the line supply of nitro-sulphuric acid used in irrigating the Glover tower; (2) through the pipes 25, conveying the 60° Bé sulphuric acid used in irrigating the Gay-Lussac tower; (3) through the pipes 26, connected with the water supply; and (4) through the pipes 27, conveying acid from the catch tank 22 of the same pipe system.

This latter acid from the lower catch tanks 22 can be cooled by means of an appropriate cooling system. The tanks are provided with outlet pipes, making it possible to remove acid which would correspond to any piping system in the series.

Attention is called to the essential difference between this process and the actual processes in use in that the former does not try merely to eliminate the heat of reaction by a more or less intense external cooling.

but at the same time that this action is going on, which is of course essential in any case, it permits the maintenance in each part of the apparatus of that reaction temperature which has been recognized to be the most favorable.

It differs equally as well from the processes caused out in towers, as for example the Opel process, in that the elimination of heat takes place in the immediate proximity of the place where it is evolved, and not

exclusively in cooling apparatus, situated at places without the towers.

It has appeared to the author that a process based on principles derived from actual experience and having certain very practical advantages, particularly as to cost of the installation and ease of operation, is worth the trouble of a trial on a commercial scale.

Such an installation has actually been erected and the results obtained will be published later.

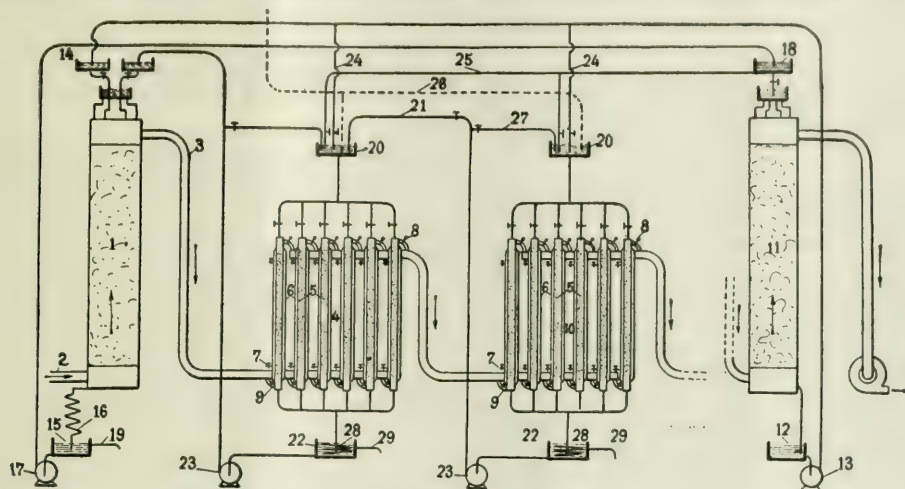


Fig. 2. Diagram of Proposed Process of Sulphuric Acid Manufacture.

Industrial Oxygen Research

AS result of a gift of \$5,000 by the Research Corporation, of which Dr. Frederick G. Cottrell, Director of the Bureau of Mines, is the founder and Elon H. Hooker, president, research work will be undertaken by the Harvard Engineering School under the direction of Prof. Harvey K. Davis, in the manufacture and industrial uses of oxygen. In consideration of its financial support, any patents ensuing from the research will become the property of the Research Corporation. Dr. Cottrell estimates the production of oxygen in the United States at 3,000,000 cu. ft., or about 130 tons, over 95 per cent. of which probably is used for cutting and welding purposes. The Linde Air Products Co., using the Linde process and operating about 50 liquefaction plants, and the Air Reduction Co., using chiefly the Claude process, produce about 75 per cent. of the oxygen consumed, which they compress in steel cylinders and distribute to the trade. The remaining 25 per cent. is obtained by electrolysis in several hundred privately owned installations producing gas for immediate industrial consumption in the plant.

At Muscle Shoals, Nitrate Plant No. 2, were installed 30 of the largest size Claude units primarily for the separation of nitrogen used in the production of cyanamid. If this installation, the largest in the world, were used for oxygen production, the daily output would about equal the total oxygen production noted above.

To make impressive the great economic importance of oxygen research and the value of increased knowledge of cheap and efficient methods of separation

of this gas, particularly to the metallurgical industries, a single blast furnace with a daily production of 500 tons of pig iron requires to be blown into it for this yield, a volume of air containing five times the oxygen produced daily by present methods and resources.

The Mutual Chemical Co. of America, 55 John street, New York, will erect a 200 by 1447 foot addition to its Baltimore, Md., plant, costing \$100,000.

* * *

Domestic production of caustic soda in Australia will be undertaken by Standard Salt & Alkali, Ltd., capital 250,000, a reorganization of the Standard Salt Co., of Australia, Ltd. The local manufacture of alkalis and allied heavy chemicals finds great encouragement in their increasing consumption and the wide spread between import prices and costs of local production.

* * *

The Philippine Refining Corporation, capital \$10,000,000, representing a coalition of American and British interests, has absorbed the Vesayan Refining Co., Rizel Refining Co. and the Philippine Refining Co., the book value of which three companies being exclusive of the capitalization stated. The English interests, with \$3,000,000 cash investment, are headed by Lord Leverhulme, who is chairman of the board of directors. Dean C. Worcester, formerly prominent in the Philippine government, Carl W. Hamilton and Emilio Aguinaldo, now and long since a strong proponent of American ideas, and Orville C. Sanborn, representing Lever Bros., Ltd., are among the directors.

Personal Items

H. G. Kogan is now associated with the Fulton Chemical Co., 207 Water street, New York, as manager.

* * *

Robb & Arnold, industrial chemists, Richmond, Va., announce that H. V. Stewart, who for the past five years has been chemist and bacteriologist for the Virginia State Agricultural Department, has become member of the firm.

* * *

A. M. Ackerman, sales manager of the chemical equipment division of the American Hard Rubber Co., will have personal charge of the company's exhibit of hard rubber equipment at the Chemical Exposition.

* * *

Henry Krissinger, formerly research engineer of the Bureau of Mines, is now with the Combustion Engineering Corporation, 11 Broadway, New York, where he will be in charge of fuel and combustion problems.

* * *

Harrison E. Patten, of the Bureau of Chemistry, Department of Agriculture, has accepted the position of chief chemist of the phosphate plant of the Provident Chemical Works, manufacturers of baking powder chemicals, at St. Louis, Mo.

* * *

Dr. W. B. Jones, formerly director of dyes at the Newark plant of the Butterworth-Judson Corp., has been appointed technical director, and will now be located at the New York office of the company, 61 Broadway. H. S. Jones, formerly assistant director of dyes, has been appointed director of dyes, with offices at the Newark plant.

* * *

E. C. Boudreaux, formerly with the Bogalusa Paper Co., Bogalusa, La., is now with Penick & Ford, Ltd., molasses manufacturers, New Orleans, La.

* * *

B. F. Dodge, formerly assistant manager of the inspection and standards division of the Du Pont Chemical Co., is now with the Lewis Recovery Corp., rubbert solvents recovery, Boston, Mass.

* * *

A. J. Lewis, formerly with the Bureau of Standards, Washington, D. C., is now with the H. H. Franklin Mfg. Co., paint and varnish manufacturers, Syracuse, N. Y.

* * *

R. P. Diker has severed his connection as official tester and grader with the New York Produce Exchange to assume charge of the oil-refining and hydrogenation department of the Brecht Co., manufacturers of refining equipment, St. Louis, Mo.

* * *

John Jacob Bausch, the nonagenarian founder and president of the Bausch & Lomb Optical Co., Rochester, N. Y., celebrated his ninetieth birthday on July 25 by the contribution of \$50,000 to the benefit fund, and the distribution of \$250,000 among the several thousand employes of the plant.

In dealing reminiscently with his efforts and the growth of his organization, Mr. Bausch, Sr., said:

"Failures have frequently fallen to my lot, but I have never given up hope and have been astonished frequently at the success which has crowned my efforts in the end. Perseverance, industry, honesty and a striving for knowledge have been my objectives."

H. Berkson, formerly with the Corn Products Refining Co., is now chief chemist with Albers Bros. Milling Co., San Francisco, Cal.

* * *

Robert E. Kendall, formerly with the E. I. du Pont de Nemours & Co., is now chemical superintendent of the Port Ivory, S. I., plant of the Procter & Gamble Co.

* * *

Howard B. Bishop, formerly with the National Aniline & Chemical Co., has engaged in consulting chemical practice at 101 Park avenue, New York.

* * *

Arthur C. Metcalf, formerly with the Bureau of Chemistry, Dept. of Agriculture, is now chemist for the Republic Packing Corporation, Lockport, N. Y.

* * *

Sidney R. Dodd, formerly with the Radium Luminous Materials Corp., Orange, N. J., is now chief chemist of the Vulcanized Rubber Co., Morrisville, Pa.

* * *

Paul M. Geisy, formerly engaged in dyestuffs research with the Grasselli Chemical Co., is now with the Calco Chemical Co., Bound Brook, N. J.

* * *

Dr. A. C. Langmuir has resigned his position as chief chemist of Marx & Rawolle, Inc., glycerine refiners.

* * *

Eldred E. Besse, of Lowell, Mass., has become associated with the Hodgman Rubber Co., of Tuckahoe, N. Y., in the capacity of chief engineer.

* * *

C. H. Baker, formerly with the Public Service Corporation, Newark, N. J., is now connected with the Diamond Alkali Co., Painesville, Ohio.

* * *

Gano Dunn, president of the J. G. White Engineering Corporation of New York, has been chosen second vice-chairman of the National Research Council for the year beginning July 1, 1920.

* * *

John Murray, formerly sales manager of the Southern Cotton Oil Co., 120 Broadway, New York, is now associated in a similar position with Stern & Sons Co., 12 John street, New York.

* * *

Dr. R. B. Moore, chief chemist of the Bureau of Mines, has been appointed chairman of the National Committee on Platinum Theft Control organized by the American Chemical Society to cope with the nationwide campaign being waged by platinum thieves. In addition to the chairman the committee is composed of Charles H. Kerk, of Bishop & Co., platinum dealers at Malverne, Pa., and George F. Kunz, of Tiffany & Co., of New York City.

* * *

John A. Stoner, formerly treasurer and assistant secretary of Marks & Rawolle, Inc., New York City, and William H. Matthes, formerly Chicago manager for the same concern, are now connected with Wm. Zinsser & Co., manufacturers and dealers in shellac and paint materials, 195 William street, New York. Mr. Matthes will be general manager of the Chicago plant of the Zinsser Co. Mr. Stoner will direct the business of the orange shellac department.

Industrial Notes

Industrial Grain Products Corp., Buffalo, N. Y., has acquired two distilleries at Frankfort, Ky., and will use them for industrial alcohol production.

* * *

Indiana Atomized Fuel Co. will erect at Evansville, Ind., a plant costing \$150,000 for the manufacture of pulverized coal.

* * *

The Southern Asbestos Mfg. Co., Charlotte, N. C., will build two additions to its plant, to cost about \$65,000.

* * *

Interstate Smelting and Refining Co., 29 Commercial St., Newark, N. J., has acquired 70,000 square feet of property at Hawkins St., and Plum Point Lane for the erection of a new smelting plant.

* * *

Swift & Co., Chicago, have completed plans for a one-story fertilizer plant at LaGrange, Ga., 200x350 feet, to cost about \$250,000, including equipment.

* * *

International Aluminum Co., controlled by Detroit capital, has purchased the five sulphuric acid units and two nitric acid and two acid recovery units at Nitro-W. Va., and will engage in the manufacture of fertilizers and chemicals.

* * *

Turner Construction Co., 244 Madison Ave., New York, will erect a \$400,000 four-story reinforced concrete plant for the Stein-Davis Co. (subsidiary Stein-Hall Co., Inc., 61 Broadway), manufacturers of tapioca flour and starches.

* * *

Naugatuck Chemical Co., Naugatuck, Conn., will build a four-story, 60x80 addition, costing \$75,000. Lockwood, Greene & Co. are the engineers.

* * *

The Natural Fertilizer Co., Fernandina, Fla., recently organized with a capital of \$500,000, is planning for a fertilizer manufacturing plant at St. Augustine, Fla. I. B. Brussels is president, and D. N. Chadwick, Jr., secretary and treasurer.

* * *

The Prest-O-Lite Co., 30 East Forty-second Street, New York, manufacturer of acetylene equipment, will build at Philadelphia a plant costing \$75,000. A similar plant also will be erected at Cambridge, Mass.

* * *

The Edward Katzinger Co., manufacturer of bakers' and confectioners' supplies, Washington Boulevard and Sangamon Street, Chicago, has awarded a contract for a seven-story extension, 100x121 feet, to cost \$500,000.

* * *

The Southern Dyestuffs Corp., capital \$1,000,000, in which New York and New Jersey chemical men are interested, have acquired at Nitro, W. Va., the solvent recovery plant of the Government munition establishment, and will transform it for the production of dyestuffs. On completion of additional buildings 150,000 square feet of floor space will be available. C. L. Masters is general manager and chief chemist.

The Firestone Tire & Rubber Co., 1871 Broadway, New York, has awarded contracts for a new tire plant at Hamilton, Ont., to cost about \$1,000,000, including equipment.

* * *

The Navy Department is proceeding with the original plans for the construction of the helium plant at Fort Worth, Texas, involving the expenditure of \$5,000,000. The pipe line to Petrolia has been completed for some time. The Reagan Construction Co., Baltimore, Md., has been awarded contract for gas storage equipment, 200x400 feet, of sheet steel, a settling basin and piping for water supply.

* * *

The Miller Rubber Co., Akron, Ohio, has acquired an 80-acre site at Nitro, W. Va. It will add to the buildings thereon a 4-story plant for the manufacture of rubber products.

* * *

The Union Sulphur Company, 17 Battery Place, New York, has purchased the four-story building at 56 West street, plot 31 by 88 feet, at the south corner of Rector street. It is reported that the company will erect a building for its occupancy. The site is opposite the large plot on Rector, West and Washington streets on which the Barrett Company is erecting a seventeen-story office building.

* * *

L. A. Baldwin and W. H. and C. B. Barber, of Glens Falls, N. Y., have incorporated the H. Ames Chemical Works with a capitalization of \$100,000.

* * *

The Muscatine Packing Co., Muscatine, Ia., has awarded to the Federation Construction Co., Sioux City, Ia., contract for the construction of a four-story, 54x64, fertilizer plant, in connection with its projected \$1,000,000 packing plant.

* * *

N. W. Hardin, Mayor of Blacksburg, S. C., is interested in the organization of a Portland cement plant in his community, and desires data and prices on equipment.

* * *

The Commission of Alsace and Lorraine appointed by the French Government announces that the production of potash salts in Alsace during the year 1919 was 591,471 tons, an increase of about 65 per cent. over the production of 1913, which amounted to 350,341 tons. It is believed that this output will be greatly increased in 1920, as there was a considerable decrease in production resulting from the difficulties connected with the transfer of the mines from German to French hands.

* * *

Meigs, Bassett & Slaughter, Inc., chemical engineers, 210 South 13th street, Philadelphia, have taken over the interest of Dr. Samuel P. Sadtler in Samuel P. Sadtler & Son, analytical and research chemists, and have incorporated the firm as Samuel P. Sadtler & Son, Inc. Dr. Sadtler is retained as the expert consultant, and S. S. Sadtler has been elected president, with Dr. H. P. Bassett and B. G. Slaughter as vice-presidents and C. C. Meigs as secretary-treasurer.

Business of the Virginia Carolina Chemical Co. for the fiscal year ending May 31, 1920, netted a surplus of \$7,352,046, which shows, after preferred dividends, earnings of \$20.26 per share on \$27,984,400 common stock, as against \$18.08 per share for the preceding year

* * *

What is said to be the largest single deposit of asphalt in the United States at Daugherty, Oklahoma, is being worked by the Continental Asphalt & Petroleum Co., of Oklahoma City. In Carter and Stephens counties of this state great subterranean lakes of liquid asphalt have been found by oil-well drillers. The increasing demand for the mineral hydrocarbons is making available the capital necessary for their recovery, and several corporations are now operating in this region on an extensive scale.

* * *

East Aurora Vegetable Oil Refineries, Inc., capital \$100,000, with offices in Marine Trust Building, Buffalo, N. Y., and plant at East Aurora, N. Y., has begun operations in the refining, bleaching and deodorization of vegetable oils. The officers are C. H. Cotton, president; H. A. Smith, vice-president, and M. F. McFarland, secretary and treasurer.

* * *

Strong financial interests connected with the American Linseed Oil Company are reported to be negotiating with a British syndicate for the sale of a large interest in the company. The British syndicate, it is stated, is headed by Lord Leverhulme, who is president of the Lever Co., of England.

It is stated that the probable outcome of the negotiations will be the merging of the American Linseed Co. and the Lever Co. and the formation of a holding company, stockholders of the two companies to be given the right to exchange their holdings for stock in the new company. Stockholders who will not want to exchange their holdings, it is stated, will be given the right to surrender their stock at par.

The Lever Co. carries on the same business as does the American company, and a merger of these two companies would give them a dominant position in the distribution of their products.

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CHEMICAL AGE

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The Government Scientist and the Conditions of the Service

By Dr. Carl L. Alsberg

Chief, Bureau of Chemistry, U. S. Department of Agriculture

THOSE who have the welfare of chemistry in America most at heart are at the moment expressing the fear that we are developing in this country an insufficient number of chemists with training more advanced than that leading to bachelor's degree. They particularly fear that a sufficient number of men trained in the methods of research may not be ready to meet the needs of the future.

It is this feeling that is leading up to such action as the establishment through the National Research Council of national research fellowships, the object of which is to encourage promising individuals to secure that fundamental training and experience which is a necessary part of the equipment of investigators. An adequate number of such men must be developed for the industries and for the universities if chemistry in this country is to keep pace with the other sciences. A few capable men are so fortunate as to secure fellowships. For most men advanced training involves such financial sacrifice as to place it beyond their reach. They are driven, often against their will, into the industries, when both they and the industries would profit if it were possible for them to get further training.

Opportunities of Research-Training in Government Service

For such men one way out is government service. A large part of the government's work in chemistry is pure research. A recent graduate who enters a research laboratory in one of the government bureaus will have an opportunity to develop under the supervision and



DR. CARL L. ALSBERG.
Chief, Bureau of Chemistry, U. S. Department of
Agriculture.

instruction of an older man and one who is experienced in research. He will have ample facilities so far as apparatus, equipment, funds and libraries are concerned. If he is reasonably industrious, he will have security and freedom from worry as to whether or not he will hold his job. He will also receive a modest salary. In the course of a few years he should, if he has ability, have a series of publications to his credit which will give him a certain reputation; he will have acquired considerable experience as an investigator, and he will, in many instances, have learned a great deal concerning some phases of manufacturing. He will, moreover, have come in contact with a great many men in the industries and should become rather well known in some given industrial field. At this time he is likely to receive many tempting opportunities to leave the government service, and should he desire to leave it, he will have escaped the drudgery and waste of time which is the lot of the

average graduate who accepts, soon after graduation, such an industrial position as is ordinarily open to a man fresh from college. He will find, very often, that he can secure a more responsible and a better paying position than the positions that are held by many of his classmates who entered upon industrial work at once, and he is likely to find that by reason of his wider experience and training in research, he will continue to advance faster than they do.

Disadvantages of Government Service

However, service in the government has certain disadvantages as compared with advanced work at a uni-

ersity, and in presenting the advantages of the government service it is not the intention to urge any one who can secure advanced university training to choose a government appointment instead. Government work must be considered always as next best.

The training received in government service is apt to be rather one-sided and specialized. It is often inadequate in the broad underlying fundamentals and it does not lead to the doctor's degree. It is believed that those who are not in position to secure advanced training at universities can secure experience and training in the government which will make them more capable of assisting in advancing chemical science and industry than if they entered industrial work at once. Moreover, while they are acquiring this training and experience, they can be performing a valuable public service for which they receive a modest salary.

The salaries paid chemists in the government service were formerly rather better than those that were paid to members of the staffs of university faculties and somewhat less than those paid in the industries. This is a proper basis for the salaries of government scientists. Government positions, because they lack some of the agreeable features of academic life, are somewhat less attractive, and, therefore, somewhat higher salaries must be paid if the government is to secure chemists of ability.

In the university, the academic atmosphere attracts many, the social conditions appeal to some, while freedom to follow any research whithersoever it may lead is an academic right that others prize highly. In the government service there is lacking the social side of academic life, though the atmosphere of Washington with its thousands of scientists presents more professional stimulus than that of any other locality in this country. Moreover, the government chemist is limited to some extent in his field of work, for it must fall within the scope of the work contemplated by the Congressional appropriation out of which the individual salary is paid. This, of course, involves restrictions to which the university man is not subject.

Scope of Government's Work in Chemistry

Let it not be inferred, however, that the field of the government chemist is narrow. It is doubtful whether the country as a whole realizes the broad ground covered by the government's work in chemistry. Nearly every scientific bureau employs chemists, but the largest numbers are employed in the Bureau of Chemistry, the Bureau of Mines, the Bureau of Standards and the Geological Survey. Every one of these Bureaus conducts extensive work on methods of analysis as a necessary preliminary to the solution of its chemical problems.

A few of the fields of work of these bureaus may be enumerated: metallurgy, agriculture—including fertilizers, dyestuffs and organic chemicals, sugar, sugar refining, sugar plant culture, fermentation, paper and pulp, leather and tanning, fuels, alloys, rubber, inks, naval stores, oils, fats, waxes and the food industries generally. The government's work on the testing of materials covers nearly the whole gamut of manufactures. These are just a few examples, but the list might be extended. It covers a large portion of the field of industrial chemistry and no inconsiderable portion of theoretical chemistry. Indeed, a survey of all the chemical work that is going on in the various governmental services would make a most interesting and valuable volume.

It is, therefore, evident that the young chemist contemplating entering the government service has a wide

field of choice. Once he has made his choice he must stick to it unless he can effect a transfer to some other laboratory. In some bureaus the transfer of young men from one line of work to another from time to time is a regular practice, the object being to broaden and develop them. Such restrictions upon the individual's field of work as exist are more than counterbalanced by the fact that in the government laboratories the material means for carrying on work are vastly greater than those available in university laboratories. Funds for new apparatus, new equipment, assistants and the like are usually adequate. They are usually very inadequate in the universities.

The Satisfaction of Public Service

Service in the government is usually more attractive to the research man than in the industries, and, therefore, it is proper that the industries should pay somewhat higher salaries than the government. The industrial chemist has not always the satisfaction of knowing that he has performed a public service, and he is very much more circumscribed in the nature and scope of his research than is the man in the government service. Moreover, the man in the government service is expected to publish his research under his own name, but the man in the industry is rarely permitted to publish his research except by way of patents. Thus, he often misses the opportunity of acquiring a personal reputation as an investigator. He may, however, in compensation, look forward to receiving royalties as a reward for valuable discoveries. Such a reward is withheld from the government chemist. It is only fair to say that there are now pending before Congress bills that would give the government chemist some financial recognition for valuable discoveries. These bills have prospect of their early passage.

Salaries

Some years ago government salaries bore a relation to university and industry salaries based upon sound values, but this is no longer the case. The salaries paid today in the government service are very materially below those paid by the universities and by the industries.

In the Bureau of Chemistry, for example, the salary range is usually from \$1,500 to \$1,600 for a recently graduated bachelor and up to \$4,500 for older and experienced men. The average salary of all classes of professionally trained men in the Bureau of Chemistry is today about \$2,240. The lower salaries are being raised slowly by administrative action, but the upper limit has been fixed at \$4,500 by act of Congress for the entire Department of Agriculture and strenuous efforts on the part of the Secretary of Agriculture to have this upper limit removed or raised have failed. However, in some other bureaus this upper limit does not exist and the scale of salaries is somewhat better.

Every effort is being made by the administrative officials of the scientific bureaus to raise the general level of salaries since otherwise it is fast becoming impossible to continue operation of these bureaus, or to continue to perform the service that Congress and the country rightfully expect of them.

The Lure of Industry

In the Bureau of Chemistry, for example, during the past three years, the average turnover of the scientific personnel has been over 30 per cent. per annum and the technical staff which formerly consisted of 350 chemists, bacteriologists, mycologists, engineers and the like, has shrunk to 260. There has been a corresponding necessary reduction in the volume of work that

is being carried on. There has been a steady and increasing loss of technical men.

Two specific cases may serve as examples. One was a young man but a short time in the service, receiving \$2,000 a year; the other an older man receiving \$4,500 a year. Said the young man: "I have been offered \$3,000 a year to take charge of the control laboratory of a large food factory. Do you advise me to accept?"

My reply was: "If financial success is your ultimate aim, probably you can do better by remaining a little longer in the Bureau. If the career of a scientist is your aim, and if the performance of public service gives you satisfaction, remaining will give you more contentment in the end."

The older man said: "I have been offered the place of chief chemist to one of the country's large corporations at \$15,000 per annum and I think I shall decline. I am happy in my work here; it is more useful and to me more satisfying. I know from experience what the life and work of a chemist-executive is and I do not like it." The younger man resigned; the older man remained. Every other scientific bureau in the government service can tell similar tales.

Congressional Action

The situation has been recognized by Congress to the extent of the establishment of a Joint Commission on Reclassification of Federal Employees in the District of Columbia. This Commission has made a most thorough and satisfactory analysis of the situation and submitted a report in January of this year in which the reorganization of the government's employment system, together with the reclassification of the employees and the new scale of salaries were recommended.

While opinions may differ concerning all the changes recommended by the commission in the government's employment system, there seems to be agreement that the scale of salaries recommended is not excessive and that it is a vast improvement over existing conditions. At the same time that this report was made, bills were introduced to make effective the recommendations made by the Commission.

No action has as yet been taken upon these bills. What action will be taken in the coming session of Congress it is impossible to predict. One thing, however, is certain. Unless readjustments are made, the scientific service of the government will continue to disintegrate even more rapidly than it has since the beginning of the war. The situation promises to be extremely serious in its import to industry and to the public.

Devotion to an Ideal vs. Domestic Responsibilities

It is a characteristic of scientists in the government service that they are willing to remain, even in the face of offers to leave the service with material advances in salary.

Were it not for the general increase in the cost of living, the government service would not now be undermanned. It is not necessary for the government to pay salaries in competition with the industries to maintain a staff adequate qualitatively and numerically. However, under existing conditions, the salaries paid by the government are so far below those paid in the industries and in the universities that able scientists are leaving the government service in shoals.

Advantages of Government Service

This situation emphasizes in a practical way what I have said earlier in this article, viz., that far from unfitting a man for industrial life, government service prepares a chemist very well indeed for it. Of the

chemists who have left the service, the majority have accepted industrial positions. So far as the records of the Bureau of Chemistry indicate, they have left its service at advances in salary, ranging from twenty-five to several hundred per cent. and a very large proportion of the men who have left in this manner have not stood still in their, as yet, brief industrial career. Most of them have advanced very rapidly in competition with other industrial chemists.

Handicap to the Service and Personal Disappointment in Enforced Withdrawals

What has just been said must not be construed as indicating that holding a government position for a few years is not a good proposition for a young man, considering the training and experience he receives. The conditions which are forcing men out of the service affect more particularly men who are somewhat older and who had decided to make service in the government a life career. In the face of present living conditions these men were forced, reluctantly, to change their plans. The damage to the service is great, but, fortunately, a considerable number of the older men prefer to remain even at great personal sacrifice, because they regard existing conditions as temporary, and because they prefer not to discontinue their life's work.

Hope Springs Eternal While Disaster Threatens

There can be no doubt that the condition is temporary. Congress will unquestionably sooner or later take appropriate action. It is to be hoped that it will do so before the services lose any more of their older and more experienced investigators, and in consequence, go utterly to pieces.

Wood Pulp from Alaska

The first step in the utilization of the pulp-wood resources of Alaska appears in the contract entered into by the government with the California Paper & Water Power Co. for the sale of 100 million feet of pulp-wood timber located at Port Snettisham, fifty miles southeast of Juneau. It is reported that \$2,000,000 will be invested in the construction of a plant.

Forest service officials expect many new developments will take place in Alaska now that waterpower has become available under the leasing act. A rough estimate shows that the Tongas forest reserve contains about 70 billion board feet of Sitka spruce and western hemlock well suited for paper making. This timber is located in a comparatively narrow belt along the coast line and waterpower and deep water transportation are available from many mill sites. The estimate indicates the timber from that region alone will furnish a perpetual supply sufficient to meet one-half of the newsprint requirements of the United States.

* * *

Mineral Research in the South

The Bureau of Mines is planning to pay more special attention to chemical matters in connection with the work of the Bureau conducted at mining experiment stations and elsewhere. The Bureau has received claims from half a dozen Southern localities which want the proposed new chemical mineral experiment station of the Bureau established within their respective midsts. The localities are being investigated, sites offered inspected and facilities afforded considered by R. B. Moore, chief chemist of the Bureau of Mines, and others now in the South. The locations suggested include Chapel Hill, N. C.; Birmingham, Ala.; Tuscaloosa, Ala.; Knoxville, Tenn., and Atlanta, Ga.

Transformation of Munition Plants to the Needs of Peace

THE adaptation of government munition plants to peace-time industrial needs has been one of the most notable aspects of the post-war period of adjustment. Signing of the armistice found these plants in three stages of development, viz., actual operation, completion ready for production, and in process of construction. The character of the salvaging operations decided upon was determined by these conditions. Picron, near Little Rock, Ark., was sold to a corporation organized for the purpose of creating an industrial center. Nitro, West Va., shared the same experience. Other plants less advanced in development are still in government hands; as also are the nitrogen-fixation plants at Sheffield and Muscle Shoals, Ala., which a communistic administration sought to use in an ambitious plan to make the government a competitor in chemical manufacture.

Hopewell, Va., was a du Pont private enterprise that grew, in the interim preceding our entry into the war, from an 800-acre dynamite plant in 1914, designed for export and southern business, to a 2,400-acre project for smokeless powder manufacture for the British and Russian governments. With our participation in the war, Hopewell's production of smokeless powder required the labor of 18,000 employees with a monthly payroll of \$2,000,000 and a built-to-order city to accommodate a population of 35,000.

The transformation of a practically deserted community, into which Hopewell lapsed after the armistice, into a prosperous town of 7,000 population that promises to approach the Hopewell of war-time activity, is the work of private enterprise represented by the du Pont Chemical Co., which in ten months has been instrumental in locating in the Hopewell Industrial District twenty-four separate industries, eleven of which are in the former munition plant.

The industries located in the plant proper have a capitalization of \$17,500,000, with a plant investment of \$7,500,000, and will employ when in full operation eight to ten thousand hands. They comprise the following concerns:

- Hopewell Trunk & Bag Co., trunks and bags.
- Mayhew Virginia Corporation, mechanics steel tools.
- Imperial Bagging Co., reclaimed bags.
- Camp & Harman, dry cleaning.
- Hopewell China Corporation, chinaware.
- Hopewell Insulation & Mfg. Co., high-temperature insulation.
- Special Products Co., cotton and wool waste.
- Tubize Artificial Silk Co., artificial silk.
- Miracle Company, dishwashing machines.
- The Stamscott Company, paper pulp from cotton linters.
- Hummel-Ross Fiber Corp., paper and paper board.
- J. Cohen & Son, overalls.
- Hopewell Sheet Metal Works, sheet metal.
- Morris Wagon Mfg. Co., wagons.
- Petersburg Silk Hosiery Co., silk hosiery.
- McCawley & Co., men's shirts.
- Spottswood-Allison Corporation, trunk locks.
- Atkinson & Long, trunk hardware.
- Alfred Friend Trunk & Bag Co., trunks and bags.
- Titmus Optical Co., optical lenses.
- International Filler Corp., bottling machines.

The smokeless powder plant, Old Hickory, situated at Hadley's Bend, on the Cumberland River, 18 miles from the city of Nashville, Tenn., is the last great government munitions enterprise to undergo revamping for peace-time uses. It is too much to expect, under present business conditions, and its geographical location, that the success which has attended the readjustment at Hopewell will crown the government's efforts

to encourage an industrial center at Old Hickory. Already the date for submission of bids has been postponed from September 2 to September 30.

The plant was built by the du Pont Engineering Company, a subsidiary of the E. I. du Pont de Nemours and Company, the total cost being about \$85,000,000. The entire reservation may be divided into the village of Jacksonville, Tenn., and the plant proper. The village comprises 3,020 buildings capable of housing 30,000 people.

The plant proper consists of 1,021 completed buildings, of all types, covering 1,800 acres, devoted entirely to manufacturing. The plan may be subdivided into units for cotton purification, nitrating, filtering, causticizing, refrigerating, power, sulphuric acid and diphenylamine, box factory, storage tanks, and a machine shop.

The sulphuric acid and diphenylamine units are capable of furnishing 200,000 pounds of diphenylamine a month. This unit consists of 3 divisions, the nitro-benzol area, the aniline area and the diphenylamine area. The nitro-benzol area has two storage houses for benzol, two field storage tanks for the mixed acid and a waste acid shed. The reducer contains eight reducers of 1,800 gallons each, which reduce the nitro-benzol to aniline and deposits it in the receivers. In the diphenylamine area are two autoclave houses containing twelve autoclaves each, and a distillation, graining and packing house for the finished product.

According to the report from an investigation of the possibilities of the Old Hickory plant, the equipment of this unit and in fact the entire unit "can be adopted for the paper manufacturing industry, for the making of cellulose and for the manufacture of photographic film. It has been inspected by a paper engineer and pronounced ideal for either paper or pulp. Inasmuch as the cotton when purified and about to leave this particular unit, is almost in a state similar to cellulose, the plant is adaptable for the manufacture of photographic film. All the mechanical equipment is in splendid condition. With minor changes this equipment can also be adopted to scrubbing and purification of wool for woolen mills. There are also seven complete nitrate houses, each with ten 427 centrifugals driven by 40 h. p. vertical motors. The equipment can be easily applied to the drying of soluble or insoluble chemicals, salt, and in the drying of sugar or wool."

Expansion of Aetna Explosives Co.

The Aetna Explosives Co., 165 Broadway, New York, and its subsidiary, the Aetna Dynamite Co., have plans under way for expansion in manufacturing plants. The work will utilize surplus funds of the company and for the most part will cover the production of by-products. The Research Laboratories of the company are developing plans for the extensions. Benjamin B. Odell is president.

The technical administrative staff comprises: C. A. Bigelow, general manager; C. H. Cordic, general superintendent; O. G. Pratt, chief engineer; Sam Rand and F. P. H. Sholley, assistants to general manager; R. B. Smith, assistant technical director, and N. A. Laury, in charge of heavy chemical manufacture.

Responsibilities of Technical Men and Obligations of the People

By Warren G. Harding

United States Senator

NO one can be more appreciative than myself of the great advantages of a college education. I took my post-graduate course in the university of country journalism. This appreciation of the value of college education and of the value of college-trained men in a democracy, has deepened with maturity and experience in public service.

Our civilization is an industrial civilization. Its problems primarily are those of production and distribution, which, to be solved from the standpoint of the maximum welfare of all our people, must find their answer in an ever greater volume of cheaper goods of higher quality; otherwise, a progressive standard of living cannot be maintained, and the law of life which is growth, hence, will be thwarted.

The solution of these problems, is, in the aggregate, a tremendous responsibility which rests directly with technically educated men who are trained primarily for this work.

It is not too much to say that the future of society today is in the hands of technically educated men, for they are concerned directly with the operation and management of the material forces which radiate their influence into every avenue of human thought and aspiration.

The rapid progress we have made in the fundamental, material things of life, is the result of the study and work of men of this type, and reflects the value to society of specialized ability, for in no other way than by specialization of effort could such great contributions be made to the common welfare.

The same specialization whose results in the aggregate are so valuable to society has its drawbacks which, in so far as the individual practitioners of the great technical professions are concerned, tend to confine their respective interests to their immediate work to the sacrifice of activity in the broader field of public affairs.

Government increasingly is becoming more technical, because its great problems more than ever before are essentially technical problems, particularly as they relate to internal affairs of development and more efficient utilization of our natural resources, which in many things are dangerously approaching exhaustion. Not only must these be conserved, but substitutes must be found and developed.

This work is the duty of men best qualified to do it. These men are the technically educated men, who form the industrial "shock troops" of the army of civilization. They are civil engineers, mechanical engineers,



WARREN G. HARDING.
United States Senator.

electrical engineers, mining engineers and metallurgists, chemical engineers and chemists, and, lastly, that body of faithful men who constitute a condition precedent to all the rest, the teachers of technical men.

Government is looking more and more to these men for the great public service of development and more efficient utilization of our material resources.

The conditions of our time demand that technical men shall concern themselves with public affairs and reflect upon their respective professions the popular recognition accorded to members of the legal and medical professions and the ministry.

Representatives of the engineering professions should sit in our state and national legislative bodies, instead of being merely the administrative agents of the great engineering projects that our intensive civilization now demands shall have greater fruition.

Our government maintains great scientific agencies in the Patent Office, Bureau of Mines, Bureau of Standards, the Geological Survey and the Bureau of Chemistry and Experiment Stations of the Department of Agriculture.

Here engineers and chemists and representatives of every department of applied science are employed under capable scientific administrators, to encourage the development of our natural resources, to discover new processes for their utilization, and to protect the inventive mind in the fruits of its prolific genius to which we are indebted more than to any other one source for the material greatness of our country.

These agencies must be supported liberally, for their work is as seed which yield their harvest in the increased fruitfulness of all human endeavor in field, mine and factory.

Not only must these agencies have adequate appropriation from our national and state treasuries to solve the problems demanding solution with increasing insistence, but the scientific workers therein must have a wage that not only represents a balancing of the changed economic conditions, and which to a greater degree than at present will permit government to compete with private industry for their services, but which will encourage the development of a type of scientific investigators qualified to cope with the exacting demands of research, without which industrial progress will stagnate.

Team work finds its highest exemplification in the successful manufacturing organization. He who gives the most receives the most. The rewards of competi-

tive industry do not go by favor but by capacity.

We want in government the methods of industry, and we should avail ourselves to a greater degree than ever before of the wisdom of men who have made American industry one of the wonders of the modern world.

The great technical professions form the cornerstone of material civilization. Their practitioners are derelict

to their greater social responsibilities in their indifference to political affairs.

I want to encourage that interest and will help to reward the effort.

As one who appreciates the value of their work and worth, I pledge myself to aid our technical men in all matters looking to the popular recognition of their respective professions.

The American Institute of Chemical Engineers

By David Wesson, President

THE Sixth National Exposition of the Chemical Industries not only shows the advances made in applied chemistry during the past year, but particularly calls attention to the work of the chemical engineer, without whose services there would not have been very much of an exhibit.

The profession of chemical engineering has had a rapid development due to the need of translating the results found in the laboratory into successful works practice. The chemist who might discover the principles of a valuable commercial process often might find himself perfectly helpless to develop it without a practical knowledge of engineering principles.

To a man mechanically inclined this was not a difficult matter, but to the chemist who had to trust to the casual engineer to put his ideas into practice, something more than a mere chemical knowledge was needed. He has to be endowed with executive ability, horse-sense, a good, all-around knowledge of physics as well as chemistry, and good judgment. These qualifications have taken many chemists out of the laboratory into the works and ultimately have landed them as the heads of large industrial enterprises wherein chemistry is a leading factor in successful production.

The proper definition of "chemical engineer" has been a matter of more or less controversy. It would seem, in the broadest sense, that a chemical engineer is one who successfully manages chemical enterprises or applies chemistry to industry.

The American Institute of Chemical Engineers, founded in 1908 on a high code of ethical and profes-

sional qualifications, has, during a slow but healthy growth in members, increased steadily in influence during the past twelve years. The great care of its membership committee to pass on the professional qualifications and standing of applicants has done much to raise the prestige of the Institute.

With the steady increase in membership it becomes incumbent on the membership committee to exercise greater and greater care in passing upon applicants, with the result that the standard necessary for membership will be raised as time goes on. The Institute, in consequence, will have an ever increasing influence upon the welfare of the country in general, and the profession in particular. In adding to its membership the watch-word of the Institute has been "Quality First."

For a long time it was considered that prospective members should apply for admission. The result was a large number of undesirable applicants tried for admission, while the men who would have added lustre to the Institute did not apply. The plan recently has been changed, and it is now the practice of members of the Institute to select the men they believe should belong and invite them to join.

The Institute wishes its new members to feel that they are being honored in joining and at the same time the Institute wishes to feel that it is being honored by having them upon its membership roll. Working along this principle, the Institute is passing through a very prosperous year, and the prospects for its future look very bright.

B. T. U. Standard for Philadelphia Gas

Acute shortage of crude oil, hitherto used in large quantities by the United Gas Improvement Co., which hold the exclusive franchise for supplying Philadelphia with gas, was recognized by the City Council. An ordinance has been passed approving a change of the lease between the city and the company whereby the British thermal unit standard is permitted as substitute for the candle power requirement hitherto enforced. Originally the lease specified 22 candle power but several months ago the standard was lowered to 18 candle power and under the new arrangements the decrease is to 14 candle power. The B. T. U. standard is set at 530.

Standard Paper Mfg. Co., Richmond, Va., will enlarge its plant by a remodeled addition, recently acquired, costing \$500,000.

The Canadian Industrial Alcohol Co., of Corbyville, Ontario, successor to the Corby Distillery Co., is now devoting its entire attention to the production of industrial alcohol. The output has reached 20,000 gallons per day, as against 3,000 gallons of whiskey per day before the war, when prohibition had not endangered the prospects of the beverage liquor industry. Molasses is the main raw material, this being brought from Cuba and delivered in tank cars, as grains are out of the question, owing to price.

The Secretary of Agriculture has created the Office of Development Work in the Bureau of Chemistry. David J. Price, chief engineer in the dust explosion investigations conducted by the department, will be in charge.

The work will comprise the translation of the scientific discoveries of the Bureau into production uses by providing prospective manufacturers desirous of using industrially newly discovered processes with full information as to manufacture on a quantity-production basis.

New Developments in Coal Tar Chemicals and Specialties

By Herbert G. Sidebottom

Manager, Technical Service Department, The Barrett Company

MUCH has been said and written during the last few years on the phenomenal growth of the coal-tar chemical industry. These articles, with few exceptions, have touched principally on the "whys and wherefores" of increases in production of such well-known products as benzol, toluol, naphthalene, etc., these increases having been brought about by war conditions, and having been maintained since the Armistice by increased activities in the dyestuff, pharmaceutical, and other synthetic chemical fields. However, very little space has been devoted to some of the newer developments in this field, any mention that has been made being in connection with some particular phase of development or relating to the particular use developed for the commodity.

The purpose here is to summarize briefly the work and results of researches on what might be termed "specialties" in this most important field of industrial chemistry. References to accomplishments in the intermediate or dyestuff fields purposely will be avoided.

Primary and contributing causes for initial work on the various developments to be outlined have naturally been different. A definite need may have been felt for such a material; its development may have been due to by-product work; and in the case of processes, the production of a new product may have called for an absolutely new process; or the development of the process may have been due to intensive research for improvements of old processes.

Para-coumarone Resins

A development in this industry, which has involved in a measure all four of these points, is the production of the so-called "coumarone" or "para-coumarone resins." The fact that resinous bodies could be obtained from certain fractions of the light oil of coal-tar by one of a number of means of polymerizing certain of the constituents of this fraction has been known for a number of years. These resins, of a kind, had been produced commercially in Germany some time before 1914. Considerable research had been carried on in this country prior to this date also, and had the war not interfered by making researches on strictly war materials more essential, the present stage of commercial production of these resins, in all probability, would have been reached some four or five years ago. A complete bibliography of articles, patents, suggested uses, etc., in this connection would cover many pages.

Briefly, coumarone, indene and possibly one or more accompanying products, which in themselves exist as liquids in what is commercial known as the naphtha fraction of a coal-tar distillate, have that property of being polymerized by heat and pressure treatment, or by treatment with mineral acids to form resins. These gums or resins can be and are produced in various degrees of hardness (melting points), depending upon crudes selected and the process of polymerization. They have various uses which are in general the uses of the natural or fossil gums and resins. The development of the higher melting point types is a valuable addition to our industries as this grade of gum already is helping to fill the need for some of the fossil varnish gums, supplies of which are diminishing. Their extremely high dielectric strength due to non-affinity for mois-

ture and the fact that these gums are absolutely neutral, being made synthetically by a process which is closely and chemically controlled, assure the meeting of very definite specifications and absolute uniformity.

Rubber Compounding Specialties

As a typical example of special researches in an effort to produce products for one particular industry, the work in connection with the production of a so-called mineral hydro-carbon from coal-tar basic materials for the rubber industry may be cited.

The nature of this particular investigation has been more of an effort to standardize the products than toward the discovery of new materials. At one time a very strong prejudice existed against the use of coal-tar pitch as a mineral hydro-carbon, and in all probability this was justified, because still-residues and other products of the same degree of refinement were being sold to the rubber manufacturers and no endeavor was being made to standardize or make uniform these materials.

Due to the inherent nature of these coal-tar products, their use naturally is desirable in the rubber field, and efforts to place on the market standard articles of this nature, as well as a high grade reclaiming oil from the same base, are being repaid by continually increasing demands.

Pyridine Bases

The production of a pyridine suitable for denaturing and special solvent work is a comparatively new accomplishment. A new process for its recovery from coke-oven gases has been evolved which gives a high-purity material at extremely low operating costs. The commercial article which in reality is a mixture of the so-called pyridine bases, showing a high percentage of actual pyridine, is not however being produced in sufficient quantities to supply the demand.

Anthracene, Carbazole, Phenanthrene

The endeavors to produce anthracene and carbazole as basic crudes for certain well-known dyestuff intermediates and colors from American tars have been interesting. Satisfactory grades of materials have been made. Along with these two products, which in their crude state are extracted from the oils as solids, comes phenanthrene, a solid showing a melting point of about 100° C. These three products exist in the commercial grades of each other as impurities, and can be separated by selective solvent action, but, unlike the other two, no definite chemical use for phenanthrene in quantity was known nor is yet an accomplished fact. This product, however, in a purity of about 80 per cent., on account of one particular phase of its physical appearance, namely, its waxiness, suggested its possible use as a substitute for a wax. This led to experimental work in connection with eutectics and it was found that melting points of a number of low-grade waxes could be satisfactorily raised by the addition of phenanthrene in varying quantities. It also has proven to be an interesting sizing material for paper and a compounding material in certain rubber mixtures.

Other solids exist potentially in large quantities in certain fractions of the coal-tar oils which may prove

to be of somewhat the same mechanical interest as phenanthrene. I have particular reference here to acenaphthene and fluorene, which can be made in a high grade of purity but, like phenanthrene, are also waiting for a large commercial chemical use.

Close Fractionation

The production of a material, meta-xylene, brought about by war needs, has added valuable experience to the real backbone of the coal-tar industry, namely, distillation. The separation of meta-xylene, a material boiling at 139°C ., from its two isomers, para-xylene, boiling point $137\frac{1}{2}^{\circ}\text{C}$., and ortho-xylene, boiling point $142\frac{1}{2}^{\circ}\text{C}$., to such a degree of purity as to make it satisfactory for nitration, the nitrated product being the equivalent of tri-nitro-toluol, is a triumph of distillation. The experience gained in producing this product in large quantities is now being applied in connection with the production of other extremely close boiling fractions.

Separated Cresols

The separation of one or more of the cresol isomers justly has merited and received considerable thought and investigation. The separation of the ortho-isomer by itself is comparatively simple and can be carried out by distillation. This material is being manufactured and used in large quantities in this country today. However, the separation of the meta-cresol from the para-cresol is more difficult and involves one of a number of chemical processes which render practically useless the isomer not particularly sought, and inasmuch as no definite field of use has been sufficiently developed for either isomer, this separation is not being carried on commercially.

Tanning Extracts

The development of the so-called synthetic tanning extracts has called for considerable research, particularly in the direction of producing a standardized product from the quality view-point. Products of naphthalene and of phenol and its homologues are used in this connection. An extremely bright future, we believe, awaits further developments in this field. Supplies of the natural vegetable extracts are diminishing and reforestation is not taking place very rapidly. Better and cheaper leathers are now being produced in the United States and time is being saved by the employment of such synthetic materials.

The Abbott Laboratories

The Abbott Laboratories, Chicago, Ill., manufacturers of pharmaceuticals and fine chemicals, soon will have a number of the new manufacturing buildings near North Chicago completed and ready for occupancy. At the present time, all departments of the company are located in Chicago, but the expansion of recent years has made it necessary to greatly enlarge the manufacturing department.

The Abbott Laboratories were organized by Dr. W. C. Abbott twenty-five years ago. In addition to the more common pharmaceuticals, Dr. Abbott introduced the manufacture of a large number of alkaloids which were urgently needed in this country. Since then the company has had a steady growth and under the direction of Dr. Abbott and Dr. Alfred S. Burdick, the manufacture of a wide variety of synthetic pharmaceuticals has been carried out. These include procaine, barbital, introduced as veronal; cinchophen, anesthetic, the medicinal dyes, acriflavine and proflavine; the

Camphor Substitutes

The preparation of proper grades of phenol and cresol for their ultimate use in the manufacture of tri-phenyl or tri-cresyl phosphates has been made necessary by the shortage of gum camphor. These two phosphates have found considerable use as a substitute for gum camphor in the celluloid industry. These so-called substitutes used really as solvents in this particular connection should not be confused with synthetically prepared camphor which, chemically and physically, is practically identical with the natural gum.

The investigation of the possibilities of producing products of catalytic oxidation of coal-tar basic materials has been far-reaching and, although many hours and many dollars have been spent in these investigations, so far the surface only of this enormous field has been scratched. A record of the work in this connection thus far is of infinite value to chemistry. Any number of products which have never before been produced synthetically and supplies of which, for various reasons, are diminishing, are now real possibilities. Synthetic lactic, tartaric and malic acids are possible. Malic acid already is a commercial reality. Other materials, which never have been commercially available either from synthetic or natural sources, are now being manufactured. I refer there particularly to malic and fumaric acids. They already are proving their worth in a number of commercial fields as substitutes for or equivalents of such acids as citric, lactic, and tartaric. Due to low operating costs, these catalytic oxidation processes may also lead to the production by new means of synthetic products now on the market.

In the above few paragraphs I have mentioned in general only definite products or processes. It has been said, and possibly, correctly so, that the lighter boiling fractions of coal-tar have been more thoroughly investigated than the middle or higher boiling fractions. Benzol, toluol; phenol, cresol and naphthalene are all well-known commodities. Future researches in connection with the production of these products will be in the nature of improvements and reduction of costs. Investigations, of course, will be continued in this direction, but we believe that the big new researches will be devoted in a large measure to the investigation of the other and lesser known materials we know to exist in other parts of this enormous field.

antiseptics, dichloramine-T, chlorazene and halazone, besides a number of other synthetics. At an early date the company proposes to put on the market a number of new anesthetics, hypnotics, etc., which have been developed and patented by the research staff. The Abbott Laboratories probably manufacture a more complete line of synthetic pharmaceuticals than any other American concern. It is indeed noteworthy that an American manufacturer is producing extensively the synthetic products, both new and old.

* * *

Joseph V. Meigs, formerly associated with Carleton Ellis in the latter's laboratory at Montclair, N. J., is now chief chemist with the Massachusetts Oil Refining Co., which recently placed in operation its new refinery at East Braintree, Mass.

* * *

Herbert S. Bailey, formerly with E. I. du Pont de Nemours & Co. at Experimental Station, Henry Clay, Del., is now assistant chief chemist of the Southern Cotton Oil Co., Savannah, Ga.

The Johns Process of Shale Oil Extraction

THE Industrial Process Engineering Co., St. Louis, Mo., is developing commercially an invention of George McD. Johns, a St. Louis engineer, for the extraction of oil from oil shale, with such encouragement as to warrant the early appearance of the equipment on the market.

The Johns process is continuous and utilizes the raw shale pulverized to such degree of fineness as permits the maximum efficiency of handling prior to retorting and the quick penetration of heat to all parts of the bulk material in the retort resulting in equally rapid distillation, all contributing to high capacity of installation. The carbonaceous residue, together with uncondensable gases, is the sole source of heat, that portion unused being available for briquetting or for use elsewhere in powdered form. The ash is excellent material for brick-making.

Procedure

The crushed shale is elevated to a feed-bin from which it is fed through a regulating chute into the hopper of the retort, where sufficient material is allowed to accumulate to form a seal.

Within the hopper, beginning at the foot of the feed chute, the shale is moved by a series of scrap-

the vapors as they appear from the shale. They are thus removed immediately without danger of any redistillation, insuring a natural eduction of all gases at a naturally graduated temperature.

Condensers

The condensers are designed so that gases drawn from the retort as they are produced, are gently conducted through them in the simplest way, means being provided for the greatest possible exposure of gases in transit to refrigerated surfaces. The shortest possible cut is made from the retort to the condenser, thus allowing the least possible space for condensation in the lead pipes. Any such condensation is taken care of by sealed trap take-offs. The condenser pipes are covered with cloth which is kept constantly wet by water circulation. The gas in transit is given a spiral course which compels a whirling motion in its passage, eliminating any hot core in the gas column and offering the quickest possible access to cooling surface.

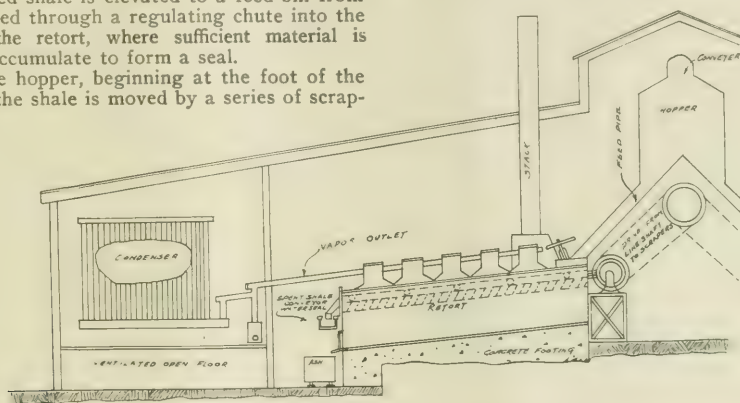


Diagram of Equipment of Johns Process of Shale Oil Extraction.

ers, operated by a speed-governing device whereby the shale is timed on its way down an incline plane until it reaches the neck of the outlet, where accumulated residue again furnishes an outlet seal similar to the seal in the inlet. The incline and scrapers act together not only to push the material forward at the proper rate of speed, but hold it from gaining too great a speed down the incline.

Underneath the plane on which the shale is traveling is a fire chamber, at the lower end of which is fed spent shale and gases, creating an intense heat which gradually reduces as it passes forward and up on the underside of the retort incline, thus graduating the heat from high to low, the low being farthest from the fire.

Thus the shale when it enters the retort, meets the lower heat and gradually on its descent, reaches the high heat, the lighter volatile vapors coming off before the shale reaches the higher temperatures necessary for complete eduction.

Two take-offs, one towards either end of the re-tort chamber, are connected by piping with an exhaust fan which is so regulated that a pull is exerted just over that necessary to lift and remove

The condenser is so arranged that take-offs from each section may be had. Different fractionations made possible by such a condenser may be drawn off either separately, collectively or in groups. Perfect operation and speed control of gas will give considerable success in fractionation in this condenser.

The ammonia scrubber is inserted in condensers near the exhaust fan. Any design of scrubber can be used.

The chief features of the equipment are continuous operation, its self-contained character, complete reduction of recoverable hydro-carbons, practically automatic operation, one man being sufficient, beyond crushing the raw shale, to conduct a plant. The use of standardized material without special castings or machine work, insures construction costs that make possible a commercially attractive device for operation on any scale.

F. W. Lowe, of the Oakley Chemical Co., New York, and John H. Curran, former Immigration Commissioner of Missouri, are associated with Mr. Johns as patentees and officers of the company.

Methods and Cost of Pulp and Paper Manufacture

Suitability of Southern Woods and Plant Fibres

THERE are four general processes of reducing wood to a pulp condition. These are known as the ground wood, sulphite, sulphate and soda processes of pulping.

Ground Wood Process

The ground wood process of pulping is used mainly for the reduction of non-resinous, long-fibred woods, such as spruce and balsam. The barked wood in 2-foot lengths is ground on a grindstone, the surface of which has been sharpened to produce a cutting action. The yield of pulp is approximately 90 per cent. of the weight of the raw wood. The pulp is inferior in quality and is used only to mix with longer and stronger fibred stock, such as unbleached sulphite pulp, in the manufacture of paper in which permanency is not required, such as in news-print, cheap catalog, magazine and certain other papers. It is also used to a large extent in the manufacture of wall board.

Sulphite Process

The sulphite process is used chiefly for the reduction of long-fibred, non-resinous, coniferous woods, such as spruce, balsam and hemlock, giving a yield of less than 45 per cent., based on the weight of the original wood used. This pulp can be bleached to a high degree of white, and is largely used both unbleached and bleached in the manufacture of books, news-print, wrapping, bond and tissue papers.

Sulphate Process

The sulphate or kraft process of pulping is used for the reduction of any long-fibred wood and yields approximately 45 per cent. This is an alkaline process and can be used for the reduction of both resinous and non-resinous woods, such as the pines, spruce, hemlocks, firs, etc. Kraft pulp is normally not bleached; but on account of its strength it is used for the manufacture of kraft wrapping paper and high-test container board.

Soda Process

The soda process is restricted in use to the short-fibred deciduous woods, such as aspen, cottonwood, willow, gum woods, etc., yielding less than 45 per cent. The resulting pulp is invariably bleached to a high degree of white, and after admixture with a longer and stronger fibred stock, such as spruce sulphite, is used for the manufacture of book, lithograph, envelope papers, etc.

Construction Costs

No accurate figures are available as to the cost of a pulp and paper mill, but it is the opinion of the laboratory that under the present conditions a balanced pulp and paper mill cannot be erected at a cost of less than \$45,000 or \$50,000 per ton capacity of finished paper per day. It is not feasible, except under abnormal conditions, to erect a pulp plant of less than 25 tons capacity, requiring approximately 60 cords of wood a day. Before proceeding with the erection of a pulp and paper mill a competent engineer who has specialized in this field should make a very careful survey of the economic conditions, such as labor, markets, living conditions, cost of fuel and power, as such factors are of decided importance in determining the financial success of the enterprise.

Suitability of Southern Woods for Pulp and Paper Manufacture

In the South there are large stands of various species of pines, including long-leaf and short-leaf yellow pine,

scrub, pitch, loblolly, etc. These woods are characterized by having a good fibre length. However, on account of their pitch content it is not believed that they can be reduced by either the sulphite or ground wood processes of pulping to a grade of pulp to compete commercially with that made from northern non-resinous, long-fibred, coniferous woods, such as spruce, balsam, or hemlock.

The various species of southern pines can best be reduced by the sulphate, or kraft, process of pulping, and the resulting pulp utilized for the manufacture of kraft wrapping paper or high-test container board. These pines can also be reduced by the soda process and the resulting pulp utilized in the manufacture of grades of paper in which sulphate pulp is ordinarily used. It is possible that further work will demonstrate the feasibility of pulping these pines by the sulphite process, bleaching the pulp to a satisfactory degree of white and mixing it with short-fibred sulphate or soda pulp made from other southern woods, such as the gum woods, for the production of magazine, book, envelope, or lithograph papers. The yield of pulp by the soda and sulphate processes is less than 45 per cent.

The large stands of hardwoods occurring in the South consist in part of the various species of gum wood, cotton wood, sycamore, basswood, magnolia, willow, etc. All of these woods are short fibred and, according to laboratory experience, can be most satisfactorily reduced by the soda and sulphate processes of pulping. This pulp, after admixture with a longer and stronger fibred stocks, such as bleached spruce sulphite or pine sulphate, can be used for the production of book, envelope, or lithograph paper.

American Conditions Unsuitable for Plant-Fibre Paper

As regards the possible use of plant fibres, such as sugar cane bagasse, corn stalks, cotton stalks, the various straws, etc., for pulp and paper manufacture, it is believed that these various fibres are not economical for pulping under present American conditions, as they offer the following difficulties in handling:

1. Plant stalks, straws, grasses, etc., usually contain a large percentage of pith, giving pulps low in fibre-content and requiring high chemical consumption.
2. Material of this type represents seasonal crops, so that facilities must be provided for the storage of a large volume of the stock in order to permit the paper mill to operate throughout the year. The susceptibility of such material to decay adds greatly to the costs and difficulties of storage.
3. Due to the bulkiness of these materials, the digester charge is reduced, thereby reducing the yield and increasing overhead costs proportionately.

Some of these fibres, such as the straws, are being pulped at the present time for use in the manufacture of corrugated board and cheaper board products. Pulp of this nature, however, does not compare with a refined pulp, such as sulphite or rag stock; it can be used only for special purposes and not in the manufacture of news-print or high grade paper. Plant fibres of this nature are being reduced commercially in Europe, where economic conditions and the scarcity of wood permit their utilization. But under present American conditions, it is believed that such fibres cannot compete commercially with wood pulp.

Technical Sales Service in Dyestuffs Merchandizing

By Chas. H. Stone

Vice-President and Sales Manager, Atlantic Dyestuff Co.

THE selling of dyestuffs is the greatest confidence game of which I know.

The three primary factors which should, and usually do, control the merchandising of dyestuffs between producer and consumer, which is the chief phase of dyestuff merchandising that has to be considered by the American dyestuff manufacturing industry, are quality, service and price.

The sales departments of American dyestuff manufacturers have had to contend with, and overcome, great difficulties in the quality, both as to fastness and uniformity of their products. Prior to the war, when, as a rule, there was either an abundant or over-supply of most standard dyes, and when dye-makers were not being crowded to the limit for production the broad question of quality had been almost eliminated from consideration; the number and variety of colors was so great that it was a question of determining the needs of the particular case, and then selecting the color or colors known to conform to them.

Until within a few months, the demand for dyes has been so urgent, and the number to be had has been so limited, that the utmost skill in the handling of those available, and the utmost patience on the part of the dyer in the use of poorly standardized colors, has been called for and exercised.

With the rapidly increasing range of high grade colors, better manufacturing facilities for quantity production, and a clearer conception of the user's needs on the part of both manufacturer and dye tester, the comprehensive question of quality is causing less and less concern to seller, buyer, and most of all, to dyer.

Service, from whatever angle considered, has been entirely upset by the war, and the readjustment period out of which we have not yet passed.

Service, in the form of stock on hand at the dye factories as in pre-war days, is still next to impossible; stocks in warehouses are even more difficult to maintain, although be it said that the American dyestuff manufacturers, in their usual super-efficient way, have gone even further than in pre-war days, in placing their wares convenient to the user.

Technical sales service is certainly superior to what we have ever known before; most of the American dye manufacturers have made it an invariable rule to take into their sales organizations only technically trained men, and many of these have not been sent out into the trade until they have had ample training in the dye application laboratories of their employers. This policy, in my judgment, cannot be criticized from any angle; this means that the order-taker is seldom found in the American dye-stuff sales organization. I believe every salesman of every American dyestuff manufac-



CHAS. H. STONE

Vice-President and General Manager.

turer is at least entitled to one hearing by every dye-stuff buyer upon whom he calls, and I think he is receiving such; certainly every man that is sent out has the opportunity to be of service, in some respect, to the buyer whose time he is asking.

The laboratory service, comprehending various kinds of dye matching and dye testing for those dyestuff buyers having no facilities for this class of work, has been brought to a high degree of efficiency, not only by utilization of men of long training in this work, but by the addition of keen young men recruited from our technical schools, who quickly grasp the necessities of the work in hand, as well as a good working knowledge of the products to be used. True, a man with a knowledge of the dyes available in pre-war days certainly has the advantage, in many respects, over the man without this knowledge, but the youngster with a knowledge of only American-made dyes sometimes more quickly solves the demands of the trade than does

the man who knows the old types, and lets his longing for them dampen his desire to solve the customer's needs with the products in hand.

I am glad to say that the sales manager's position to-day is being made more and more easy by the acute, well trained young men, constantly coming into the industry from the technical schools.

Prices naturally cut an enormous figure in the sale of any class of merchandise, measured to a considerable extent by the class of the merchants.

Being responsible for the general sales policy of the organization with which I am connected, I am doing all in my power to maintain this policy on as high a plane as is to be found in any other industry; in the consummation of this course I am constantly calling on the men associated with me, as well as those with whom we do business, to point out my deficiencies, so that they may be corrected, and thus bring our policies and methods to that high plane, and make them as free from justified criticism, as it is possible to do.

With the excellent service in the way of high quality, good standardization, technical travelers and laboratory experts, the question of price becomes one of minor consideration, so long as the buyer is convinced that the product he is getting is of the highest quality, and that the commercial methods of the supplier are above question.

Fortunately for all concerned, mills are buying more and more by sample, which they are able to do on account of the technical men they have in charge of either their dye-house or dye-testing laboratory. Whenever a mill does not have its own small-scale dye testing facilities, then comes into play the facts I have in mind when I designated the selling of dyestuffs as the

greatest confidence game I know, because the buyer really has no means of determining what he will get from the seller until he has begun to actually use the dyestuff received; and as much of the material dyed to-day has an enormous value, it becomes of prime importance that its quality be not deteriorated or destroyed by the use of dyes of uncertain or improper quality.

Industrial Alcohol

By James M. Doran

Chemist, Bureau of Internal Revenue

THE history of the development of the alcohol industry in the United States is to the chemist an extremely interesting one. Its close relationship to the fiscal policies of the Federal Government in the past and present interest the economist, and its vital relationship to the established policy of National Prohibition brings the industry to the immediate attention of all. It is a significant fact that the rapid development of chemical industry in this country during the past few years on account of the World War (in which alcohol played a vital part) has been coincident with the passage of the most far-reaching restrictive legislation so far enacted against the beverage use of alcoholic liquors in any country where chemical industry is important to its economic life.

The layman thinks of alcohol largely in its beverage sense, while the chemist and industrialist regards it from the standpoint of its chemical and physical properties. The National Prohibition Act, popularly known as the Volstead Act, for the first time gave a clear legislative distinction between the two points of view. In Title II of this Act is written the death sentence of the "booze" side of this substance. In Title III of the same Act is written what to the chemist fixes the present lawful status of alcohol and assures the future development of all allied and dependent industries which are vital to a well-rounded economic life.

Following the Civil War the Federal Government placed a high tax on beverage spirits to meet the necessary demands on the Treasury. During the same period extensive frauds were discovered in the evasion of the beverage tax on whiskey, and Congress, in order adequately to protect what at that time were the vital revenues of the Government, enacted a code of revenue laws which were without parallel in their minute supervision of all phases of the distilled spirits industry.

It is unfortunate that the commercial alcohol industry developed in this country under the incubus of the beverage spirit tax laws. The construction and operation of the plants thereunder were not by any means as efficient as would have been possible under conditions where the energies were directed along economic lines rather than along those requiring continuous watching lest they run afoul of many of the numerous spirit statutes. At the present time, when only a small part of the Federal Revenue is derived from spirits, Congress has clearly recognized the necessity of encouraging commercial alcohol production and has repealed many of the onerous spirit laws of the past. An example might be cited. The law formerly fixed the period of time in which a fermenter could be filled. The minimum period was 72 hours. The actual fermenting period in a molasses house is less than 36 hours. The fermenter would be required to remain empty until the expiration of the 72-hour period. The

Therefore it becomes all the more important that the sales departments of the American dyestuff manufacturers be ever ready to win, merit and hold the confidence of the buyer who has to depend upon outside sources to check the dyestuffs bought, as well as the buyer who has the facilities for comparing the delivery against the submitted sample.

removal of this restriction during war time at once doubled the fermenting capacity of a molasses house without entailing an additional penny of expense for more equipment.

About 1870 the modern rectifying or alcohol still was unknown in this country—at least it was in its infancy and was not a factor in the distilling business. There was a rectifying industry established which comprised merely the gathering together of various lots of crude pot-still distillates, treating them with lime or soda, leaching through charcoal to remove odors, which were then termed "fusel oils," and then redistilling the leachings in a simple pot still. The product was the original rectified spirits. When the rectifying or column still came into use the distillate not only was of high alcoholic strength but was free from the odors which were present in the original simple pot-still distillate. As a by-product was separated out the high boiling-point alcohols, butyl, amyl, etc., which being of an oily consistency were called fusel oil. Hence, the confusion existing for years as to what was fusel oil.

During this period came the great development in synthetic organic chemistry and there were created both a demand and a market for "rectified spirits." Germany first recognized the essential relationship between an abundant and cheap supply of alcohol and organic chemical industry. The phenomenal development of her dye and coal-tar medicinal industries before the war testifies to the effectiveness of the governmental handling of alcohol production not only by removing a large part of the excise burdens, but by positively encouraging its production and subsequent manufacturing use. It might well be stated that without Germany's alcohol and allied chemical industries her military and economic defense would have crumbled two years before the armistice. France and England followed Germany's lead, but in a lesser measure.

In 1906 Congress passed the first real denatured or industrial tax free alcohol act. From rather humble beginning the use of denatured alcohol in this country has increased remarkably. To quote statistics, approximately 2,000,000 wine gallon of denatured tax free alcohol were consumed in manufacturing the first year of the Act. During the war year of 1917, 55,000,000 gallons were used and during the past year of 1919, a peace year, approximately 35,000,000 gallons were used. Today more denatured alcohol is used than pure alcohol.

A certain amount of pure alcohol always will be an essential, but for industrial purposes the increased use for the future will be along the lines of denatured alcohol.

Lest there be some confusion as to the term denatured alcohol, it might be stated that ordinary "completely denatured alcohol" is adaptable only to certain uses and processes on account of the nature of the denaturants used, that is, wood alcohol, kerosene, benzol, pyridine, etc.

Specially denatured alcohol (and there are some 35 special formulas now authorized) cannot at present be handled except for specified purposes, but the theory along which it is being developed is the addition to the alcohol of some material which will prevent its beverage use but enhance its value for commercial purposes.

An example of this is special Formula No. 35, which is alcohol containing 5 per cent. of added tetrachlorethane. This formula is authorized for use in artificial silk manufacture. Tetrachlorethane added at the denaturing plant not only prevents the beverage use of the alcohol but places in the hands of the manufacturer two of his raw materials ready mixed. It does not take a very keen imagination to perceive at once the possibilities in denaturing alcohol for specific manufactures which not only makes the raw material tax-free but removes at once the trouble and annoyance of handling and storing pure alcohol which is the bane of manufacturers nowadays as well as the prohibition officers.

The use of alcohol as a motor fuel is already firmly established. It is not fully apparent where the supply of raw material will be found to produce the quantity of alcohol which will be necessary to replace the enormous present gasoline consumption. The cost factor is such at this time that alcohol fuels are on a practical competitive basis with gasoline. If new processes are developed for the conversion of cellulose into sugar and thence into alcohol, increased production may be looked for along these lines. Our present supplies of alcohol, however, must come from saccharine materials, principally waste molasses and grains.

The center of gravity, so to speak, of the alcohol industry of the country has moved during the past few years from the Middle West grain belt, where it developed collaterally with the beverage spirits industry, to the seaboard where Louisiana, Cuban and Porto Rican black strap molasses can be had without added transport expense.

In Hawaii, where no natural petroleum is available, a very profitable alcohol motor fuel industry has been developed, the molasses used being formerly pumped into the sea. Another probable source of alcohol for subsequent use as motor fuel in Hawaii is the wastes from the pineapple canneries. A number of small plantation alcohol plants will probably be in operation there within a short time. A part of the alcohol produced is immediately conveyed to the ether apparatus and the ether produced is subsequently added to the alcohol, thus accomplishing a denaturation of the alcohol and furnishing increased power, at lower temperature, to the explosive mixture.

In the continental United States there are several well known trade brands of alcohol-base motor fuel now in use. Its superiority to present day gasoline in thermal power with less carbon deposit seems to have been demonstrated. As before stated we are confronted by the raw material factor. There are undoubtedly many raw materials available, such as fruits unfit for market, potato culls and the like, but the transport cost now involved in moving these materials to a large efficient plant and the uncertainty of supply still make their use a questionable commercial venture.

It is unnecessary to call attention of chemists to the absolutely essential nature of alcohol. It is the universal organic solvent. It is the only commercially available source of the ethyl group. Without it organic chemical synthesis could not have developed.

The indispensability of the alcohol industry for adequate national defense was demonstrated thoroughly during the World War. Smokeless powder production

and some of the various gases, notably mustard gas, depend absolutely on ethyl alcohol. In other words, every alcohol plant is a potential arsenal.

With a difficult Prohibition situation to handle, the Bureau of Internal Revenue has a most sympathetic attitude toward industrial alcohol. Regulation No. 61 under which the industrial alcohol features of the National Prohibition Act are administered have been drawn with the ultimate idea in mind of freeing the commercial alcohol industry of every possible restriction on the economical production and the subsequent transportation and use of alcohol.

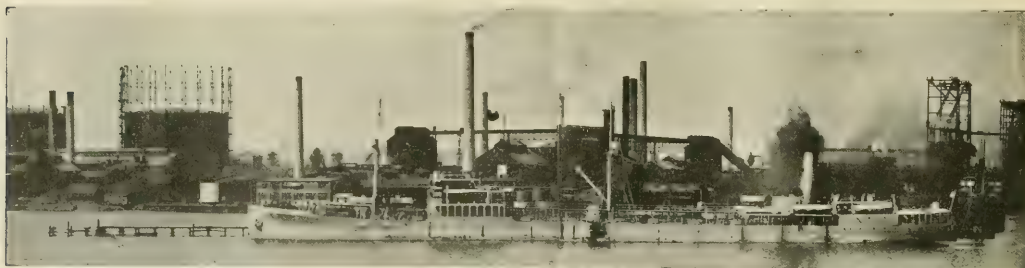
It is true that the statutes now in force and the policy of Prohibition still require a strict Government control. As experience is gained under new conditions it will no doubt be possible to draw more liberal regulations. The Act states that

"The commissioner shall from time to time issue regulations respecting the establishment, bonding and operation of industrial alcohol plants, denaturing plants, and bonded warehouses authorized herein, and the distribution, sale, export, and use of alcohol which may be necessary, advisable, or proper, to secure the revenue, to prevent diversion of the alcohol to illegal uses, and to place the non-beverage alcohol industry and other industries using such alcohol as a chemical raw material or for other lawful purposes upon the highest possible plane of scientific and commercial efficiency consistent with the interests of the Government, and which shall insure an ample supply of such alcohol and promote its use in scientific research and the development of fuels, dyes and other lawful products."

The chemists of the country can accomplish much by making clear to the lay mind the difference between beverage spirits and chemical alcohol. Unfortunately, the word "alcohol" is associated in the popular sense with intoxicating liquors and this has been a severe handicap in the administration of the National Prohibition Act itself, for the reason that, in the effort to prevent unlawful diversions, deliveries of alcohol to reputable manufacturers may be intentionally delayed and legitimate chemical operations otherwise embarrassed. Therefore, any propaganda, having for its purpose the education of the public to a knowledge of what alcohol really is and its important relation to chemical industry, should in every way be encouraged. Expressed differently, alcohol, as such, is now coming into its own under provisions of law which will eventually enable the United States to become the foremost chemical manufacturing country in the world. It is urged on all trades using the product as a raw material to assist the Internal Revenue Bureau in its labors to this end.

Proposed State Portland Cement Plant

Inadequate production of the five Portland cement plants in Texas, together with the difficulty in securing supplies without the state, which situation is not confined alone to Texas consumers of this essential material, has encouraged state officials to consider the establishment of a public Portland cement plant. The subject will be before the state legislature in January. Annual production capacity of the local plants is 500,000 barrels short of the annual demand which aggregates 2,000,000 barrels for ordinary building activity to say nothing of an additional million barrels for highway construction.



Oil Tanker Discharging Mexican Crude Oil at Refinery, Beacon Oil Co., Everett, Mass.

Petroleum Refining in New England

Within eleven months from date of breaking ground the four-years' dream of the officials of the Massachusetts Gas Cos. is visualized at Everett, in Boston Harbor, in the petroleum refinery of the Beacon Oil Co.

Plans necessarily were held in abeyance during the war. After the armistice, Clifford M. Leonard of Chicago, one of the country's most prominent constructors of oil refineries, who was planning along the same lines as the Massachusetts Gas interests, chose Everett, Mass., as the most desirable site on the Atlantic coast for a new refinery. The natural consequence was a joining of forces, and the organization of the Beacon Oil Co. with \$2,500,000 capital followed promptly. Mr. Leonard's firm, the Leonard Construction Co., put up the refinery, which has cost about \$4,000,000 to date.

The Massachusetts Gas Cos. owns about 42 per cent. of Beacon Oil Co. stock, which has recently been increased to \$3,500,000. James L. Richards, president of the Massachusetts Gas Cos., is chairman of the board of directors. Capt. W. E. McKay, long identified with enterprises owned by the Massachusetts Gas Cos. is president. H. L. Wollenberg, formerly general manager of the Aetna Explosives Co., is vice-president and general manager, and Edwin M. Richards, treasurer of the Massachusetts Gas Cos., is also treasurer of the oil company. The directors, in addition to Messrs. J. L. Richards, McKay and Wollenberg, are Robert Grant, president of the New England Fuel & Transportation Co.; Robert Winsor, of Kidder, Peabody & Co.; Galen L. Stone, of Hayden, Stone & Co.; Louis K. Liggett, president of the United Drug Co.; C. M. Leonard, Leonard Construction Co.; H. W. Endicott, of Endicott-Johnson Co., and F. E. Snow, of Gaston, Snow, Saltonstall & Hunt.

The following facts and figures describe the new

refinery, which is claimed to be as modern in construction as exists anywhere in the western hemisphere:

Property.—Substantially 100 acres of Everett, adjacent to New England Fuel & Transportation Co. and Boston Consolidated Gas Co., with direct connections to Boston & Maine and Boston & Albany Railroads and having 1,500 linear feet of deep water frontage on the Mystic and Island End rivers.

Docks and Berths.—Sufficient berthing room for two large steamers and one barge to be handled simultaneously, and even a larger number by having more than one ship abreast. Further development of company's waterfront could easily provide for four additional deep water berths for large vessels.

Pipe Lines to Storage Tanks.—Connecting the wharf with the storage tanks, located about 3,500 feet away, is one line of 16-in. pipe carrying salt water for condensing purposes, one line of 12-in. pipe for crude oil, two lines of 10-in. pipe for fuel oil, one of 8-in. for gas oil, one of 8-in. for gasoline and one of 6-in. for kerosene. Provision has thus been made for receiving crude oil and for making marine shipments of fuel oil, gasoline, kerosene, gas oil and fuel oil. The company can bunker ships right at the dock, or with its own marine equipment, can supply them out in the harbor.

Underground Concrete Storage.—There are 11 underground concrete storage tanks with a total capacity of 750,000 barrels. These tanks may be used at will either for crude oil or fuel oil, but it is the present intention to devote about 600,000 barrels capacity to crude oil (a 60-day supply at 10,000 barrels per day) and about 150,000 barrels capacity for fuel oil.

Distillation Capacity.—The distilling plant consists of two pipe stills with a capacity for topping 10,000 barrels of light Mexican crude per day, i. e., removing gasoline and some kerosene, and leaving the residuum, which is the usual commercial Mexican fuel oil. In addition to the pipe stills there are 15 cylindrical stills having a total charging capacity of 12,000 barrels.

With this plant it is possible to run 15,000 barrels a day and to produce gasoline, kerosene, gas oil, fuel oil and asphalt. If the entire plant were operated merely as a topping plant, and produced only gasoline, kerosene and fuel oil, it would have a capacity of 30,000 barrels per day.



Distilling Plant, Crude and Pipe Stills, Beacon Oil Co., Everett, Mass.

In connection with the distilling plant there are 45 steel tanks of various sizes and capacity. The plant also contains four large agitators for treating and filtering gasolene and kerosene and the necessary equipment. There is also an acid sludge treating plant. All operations in the refinery require the transfer of liquids, which is accomplished by pumping. The plant has all told about 60 pumps.

Steel Storage Tanks.—The so-called tank farm contains 18 steel storage tanks having an aggregate capacity of about 200,000 barrels, which will be used for storing finished light products, such as gasolene, kerosene and gas oil. Adjacent to the tank farm is a double track steel bridge loading racks with which 18 tank cars could be completely loaded in one hour.

Power.—The boiler house is of the most modern type of construction, containing six 500 horsepower boilers, all equipped for burning residuum which will be produced in the refinery. The boiler house also accommodates two power units for furnishing the electricity required at the plant.

Fire Protection.—Consists of a high pressure system with three independent sources for water, and a very complete Foamite system; also safety steam lines, portable engines, hose carts, etc. The plant is insured at a rate said to be the lowest written on an oil refinery.

Initial Operations.—The first oil tanker, the *Sepulga*, arrived at the refinery on July 6th, with 80,000 barrels of Mexican crude oil. The *Sepulga* started back to Mexico with 4,500 barrels of fuel oil in her tanks produced by the refinery from her own cargo of crude oil, with only a few hours elapsing between the time of discharging the crude oil and taking on the fuel oil. This remarkable achievement accomplished during the initial operation of the refinery, is a tribute to the excellence of design and construction of the plant and to the efficiency of the organization of the Beacon Oil Company.

Peoples Gas Light & Coke Co.

The Koppers Co., of Pittsburgh, Pa., is erecting for the People's Gas Light & Coke Co., of Chicago, under a leasing agreement with the latter company, a combined water and coal gas plant, which will be one of the largest in the world, costing \$18,000,000. Difficulty in delivery of material has delayed construction. The water gas plant is expected now to be in operation by March 1, and the coal gas plant by Sept. 1, 1921.

The water gas plant will have a capacity of 20,000,000 cubic feet a day and the coal gas plant, including 100 by-product ovens, will produce about 12,500,000 cubic feet of gas a day. When the gas plants are completed they will add practically 33 1-3 per cent. to the production capacity of the company.

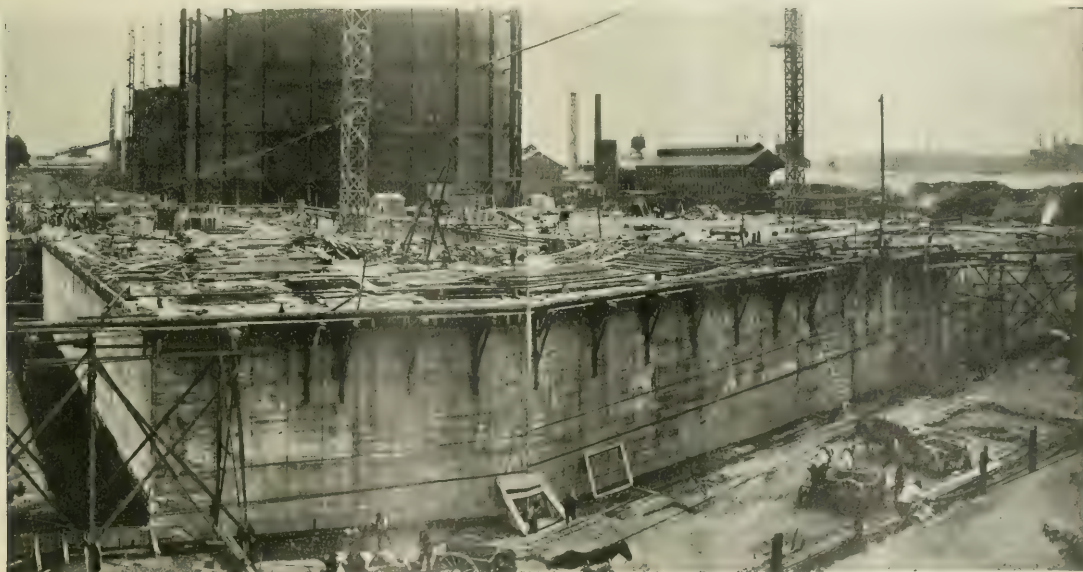
By-Products Plant for Salvaging Lemons

The practice of extracting valuable by-products from inferior or unmarketable lemons is making rapid strides in California.

The Exchange By-Products Company at Corona, in southern California, which is owned and operated by lemon growers of the California Fruit Growers' Exchange, has been working to capacity twenty-four hours a day recently in helping to salvage some thousands of tons of lemons from the wreck of the summer lemon market.

Fruit that otherwise might have been a complete loss will thus produce a good return to the grower for the class of fruit concerned. This by-products plant has used 94 tons of lemons daily, seven days a week, during the month of July and each day during the month processed 15,000 gallons of lemon juice. Later on a similar plant at another location is planned by the Exchange. **C. P. Wilson is chemist.**

Standard Utramarine Co., Huntington, W. Va., will enlarge present facilities by the erection of one-story and three-story plant additions.



Concrete Storage Tanks (Under Construction), Beacon Oil Co., Everett, Mass.

Expansion and Competition in Artificial Silk Manufacture

The operation of the law of demand and supply in the chemical industry finds interesting application in the development of artificial silk manufacture in America.

The Viscose Co., inasmuch as it is the American branch of Courtaulds, Ltd., of Coventry, England, is the projection of British interests into the domestic manufacture of this commodity, with plants at Marcus Hook, Pa., Roanoke, Va., and a third one in contemplation. The alliance of the du Pont interests with the Comptoir des Textiles de Paris in the formation of the DuPont Fibersilk Co., which will build an extensive plant on the Niagara River near Buffalo, is the projection of French interests. The projection of Belgian interests is represented by the establishment at Hopewell, Va., of the American plant of the Tubize Artificial Silk Co. Inability of existing production capacity to meet the American demand explains this expansion.

The main Tubize plant is located at Tubize, near the battlefield of Waterloo, Belgium, from which plant in 1913-14, 3,000,000 pounds of artificial silk were sent to the United States. Production ceased during the war. Shipments were resumed in July, 1919, when 10,000 pounds were shipped to the United States. In June, 1920, weekly importations reached 22,500 pounds. With pre-war production resumed at Tubize, 5,000 employees are turning out daily 15,000 pounds of filament. The Austrians turned the Belgian plant at Sarvar, Hungary, into a munition works, which saved it from destruction and permitted prompt resumption of its 7,-

000 pounds daily production. The Belgian plant at Tomazow, Poland, not only has resumed its daily production of 9,000 pounds, but is supplying munitions to the Poles.

Tenacity, elasticity, uniformity of filament and affinity for dyes, are the chief properties that receive the consideration of the textile interests. Viscose and Tubize each have its adherents.

The following table, giving the percentages of tenacity and elasticity of the two products, is submitted:

	Tenacity		Elasticity
	Dry State	Wet State	Dry State
Viscose	145	48	13.5
Tubize	170	65	13.2

This table is the result of tests made in the same room at a humidity of 65 and temperature of 22 degrees C.

With the increase of production capacity noted an early saturation of the market may be expected. According to figures presented in Chemical Age (May, 1920), American consumption in 1919 aggregated 9¼ million pounds. But for the fact that the present silk slump has somewhat decreased the normal demand for both the artificial and the real product, the aggregate present supply, furnished by the American, Belgian and other plants, would not meet the demand by thousands of pounds weekly. As it is, it barely answers the requirements. With the Fall a great discrepancy is expected.

Petroleum Production—Gasoline Recovery and Consumption

One of the outstanding features of the gasoline situation is the ability of the American petroleum refiner to increase the extraction of gasoline from crude oil. At present fully 25 per cent. of gasoline is being distilled from crude compared with 13.8 per cent. in 1918. The increase in gasoline extraction has been persistent during the last several years, a responsibility enforced upon the oil industry in order to meet the demand for gasoline which has arisen because of the increased use of automobiles. This greater recovery of gasoline is due to improved refining methods and the introduction of "cracking" processes of which the Burton system owned by the Standard Oil Co. of Indiana is the most successful.

Another feature is what appears to be greater efficiency of the automobile in regard to consumption of gasoline per car, although it is probable that less needless use accounts in part for the small amount of gasoline now being used per car. At present about 11.4 barrels of gasoline are being used a year per car, compared with 17.4 barrels in 1915.

The prospects of an early practicable substitute for gasoline in such quantities as to make it an economic factor in the motor fuel situation are so remote as to direct attention to the immediate importance of such conservation in the use of gasoline as is represented by increased mileage from available supplies. This means reduction in output of heavy, high-powered cars. It is asserted that the general use of light weight, low-powered cars of proper motor design would effect such economy in the use of gasoline that there would be little concern about supplies for years to come.

In the accompanying table is given, expressed in

barrels, statistics of crude oil production and gasoline manufacture.

PETROLEUM PRODUCTION AND GASOLINE RECOVERY, 1914-1919.

Year	Crude oil production	Gasoline production	% gasoline from crude oil	Domestic gasoline consumption
1919.....	377,719,000	94,234,000	25	86,125,000
1918.....	355,927,000	85,000,000	23.8	79,800,000
1917.....	341,800,000	67,870,000	19.8	60,930,749
1916.....	300,000,000	49,020,000	16.3	41,030,000
1915.....	281,100,000	44,042,000	15	42,772,000
1914.....	265,700,000	34,762,000	13.8	.....

Year	Gasoline exports	Change in gasoline stocks	Registered automobiles	Consumption per car yearly
1919.....	6,185,000	Inc. 1,924,000	7,500,000	11.4
1918.....	8,380,000	Dec. 3,180,000	6,146,000	12.9
1917.....	5,352,000	Inc. 1,588,000	4,983,000	12.2
1916.....	3,998,000	Inc. 3,992,000	3,512,000	11.6
1915.....	2,680,000	Dec. 1,410,000	2,445,000	17.4
1914.....	3,873,000	.....	1,711,000	....

Gasoline production in 1919 was nearly three times as great as in 1914, being 94,234,000 barrels, compared with 34,762,000 barrels, a gain of 170 per cent. During the same period crude oil production increased only 42 per cent., from 265,700,000 barrels to 377,000,000 barrels. Automobiles registered at the end of 1919 numbered 7,500,000, as against 1,711,000 in 1914, a gain of 330 per cent. Gasoline exports more than doubled between 1914 and 1918, the most important war years, but declined to 6,185,000 barrels last year, due to the fact that European countries still retained large stocks from the previous year.

Industrial Research in the Fibre Container Industry

By J. D. Malcolmson

of the University of Pittsburgh

Industrial Fellow of the Mellon Institute of Industrial Research

In a previous article,¹ the chief aspects of the fibre container industry were outlined from the manufacturing and economic viewpoints. The object of the present paper is to touch upon some of the advantages and results of applying scientific research to this industry.

The Research Fellowship of the Industry

At the Mellon Institute of Industrial Research, Pittsburgh, Pa., a research fellowship has been established by the Container Club, the association of corrugated and solid fibre box manufacturers mentioned in the first article. This Industrial Fellowship now is in its fourth year, having been renewed at the expiration of each annual contract period. The objects of this research are, in general, the standardization and improvement of the various manufacturing steps and raw materials and of the testing methods and instruments used in this country. In addition, the laboratory is used to a large extent by the members of the association for consultation. Owing to the recent and rapid growth of this industry, such inquiries often lead to special investigations on various phases of the manufacture which never before have been studied scientifically.

Work of the Fellowship

One of the earliest and most important problems which faced this industry was to develop and perfect proper testing methods. This problem related to the raw materials, the finished board, and finally to the box itself. As a matter of fact, this subject of testing methods and instruments is one demanding constant development and research, and one that still is being studied by the Industrial Fellowship.

The problem of suitable testing methods was an especially important one to the corrugated box industry, owing to the more or less intricate structure of a double-faced corrugated board. In the beginning, the only tests available were those in use in the paper industry. The most important of these is probably the bursting or puncture test, usually made with a Mullen paper tester, actuated by hydrostatic pressure. This test serves very well for the flat sheets of box board and straw paper, but erratic results naturally followed the attempt to apply this single bursting test to a combined corrugated board. In spite of this, however, the test had to be adopted as official by the railroads, since no other was available.

Research soon proved that the Mullen instrument was not adapted to the testing of a corrugated board and that it was, moreover, impossible to improve matters by any of the experimental changes which were made in the tester and its action. The final and convincing proof of this fact was secured by making up a series of corrugated board samples, having part of the corrugated straw omitted. These samples were prepared in different factories, and in each case it was shown that the bursting test was higher in that part of the sample from which the straw had been omitted.

The Webb Tester

The association then turned over to the Mellon Institute a new instrument known as the Webb tester. This had just been invented by J. W. Webb, who was in the employ of the association. It was so constructed as to make possible the testing of each face of the corrugated board separately. The new tester was subjected to thorough study in the laboratory and finally it was recommended for official adoption.² This recommendation now is in the hands of the proper railroad committee, and the tester probably will be made official in the near future.

This investigation led to the discovery of other tests for which the instrument could be used and incidentally illustrated the manner in which research often is able to branch out into unexpected fields. For instance, an accurate "crack test" for oil-cloth was developed—something which that industry always had lacked. Other novel uses were a strength test for collar button holes and a means for determining from what part of the hide a piece of leather originated. This latter determination was accomplished by measuring compressibility. The new tester was found also to be adaptable to most of the other paper products, such as solid fibre, wall board, shot-gun shells, etc.

The analytical study of fibre board and its properties offers a broad field for laboratory research. This includes microscopical, physical and certain chemical tests.

Microscopical Tests

One of the first problems encountered in the microscopical work was the development of a suitable stain for differentiating the many varieties of paper fibres often encountered in the same sample of container board. Eventually a new stain was perfected which did this successfully. Microscopical analyses are valuable for detecting the use of adulterants and many control samples are sent to the Institute every year for this test. This is because many box factories buy their box board in the open market and do not always have facilities of their own for determining just what they are purchasing.

Physical Tests

Among the more important physical tests which have been developed for box board are the various tensile tests. When these are made with and across the grain of the board, the results may be compared to show the relative distribution of the fibres in the board. If this distribution is found to be below normal, the manufacturer's attention is called to the fact, with the frequent result of a change in the factory practice. Other tensile tests are adapted to show the resistance to tearing and the bending qualities of a board, as well as the efficiency of the scored and taped corners of a box. Beam and column tests also have been designed for measuring the rigidity of the various types of board. These have a direct bearing on the ability of the subsequent loaded boxes to be tiered in warehouses and cars.

¹"The Fibre Container Industry"; *Chemical Age*, Vol. 28, 8, August, 1920.

²"The Webb Tester," *J. Ind. Eng. Chem.*, 2 (1910), 133.

Age Does Not Wither nor Custom Stale the Infinite Variety and Quality of the Fibre Container

Atmospheric humidity long has been known to have an effect on the strength of paper products. This effect, as well as that of age, on fibre board has been studied carefully and both have been reduced to fairly definite terms. For instance, it has been shown that age has no deteriorating effect on container board of good quality, even after a lapse of five years.

The structure of a corrugated board offers many interesting and valuable fields for research. Much information has been secured and distributed, covering such items as the best size and shape of corrugations, as well as their relative thickness, height, etc.

Behavior in Use

Coming now to the set-up box itself, we have a field for inquiry which necessitates experiments on a larger scale. The true measure of the value of a fibre box is its behavior in actual shipment. This method is, of course, being followed constantly by shippers and box-makers, but is inconvenient and indefinite, owing to the time required and to the irregularities of ordinary freight handling. These handicaps were overcome in the laboratory by the installation of a large revolving "drum" box tester. This drum contains a set of scientifically designed baffles, or "hazards," which compel the loaded box under test to drop on each side and corner, and this results in an excellent duplication of the treatment to which a box may be subjected in actual usage. The drum recently was used to test some 1,300 fibre boxes of all varieties, loaded with canned goods. The results enabled a complete set of specifications to be written, covering this commodity. These specifications have been adopted by the trade and recommended to the railroads to be made official.

This particular investigation also afforded an excellent opportunity for a study of the effect on the life of a box due to grain direction, different types of cans, fit of contents and methods of sealing the flaps of the boxes. The drum also can be used for studying various reinforcing or weight reducing arrangements. Thus it is often possible, as a result of such studies, to redesign a box in such a way that less material is used without decreasing the cubical contents or efficiency of the container.

The Service of the Industry

As a result of the offer of free service which the Container Club is advertising to the trade, the Industrial Fellowship has been called upon to design or improve containers and interior packing for a number of different commodities. Improved methods of packing in fibre boxes thus are being developed by this type of research, and the resulting decrease in loss and

damage is a benefit to the railroads as well as to shippers and consumers.

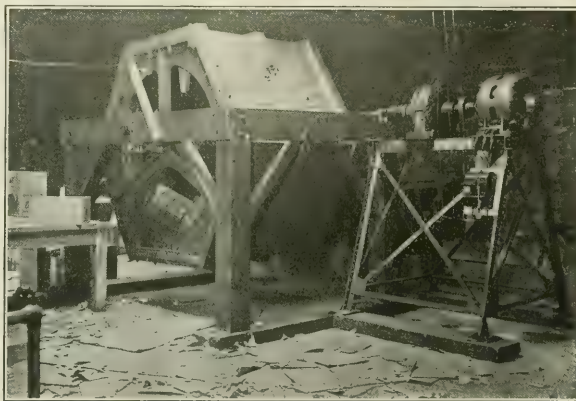
Container Accessories

In addition to the box itself, opportunities constantly present themselves for research on the accessory materials which enter into the making of a fibre box, such as gummed tape, waterproofing agents and adhesives.

Gummed cloth tape usually is used in strips two inches wide for fastening the fourth corner of the box blank. The manner in which it is made and applied compels the filling, or weak threads, to take the stresses across this corner. Research has succeeded in introducing weaves having extra strong filling threads for use in this industry. Other tests have led to this laboratory writing detailed specifications for tape covering such properties as tensile strength, size, number and twist of yarns, flexibility, loading and adhesive quality. It also has been recommended that tape be purchased primarily on a basis of cost per unit of tensile strength in the filling direction.

The only adhesive used in assembling the components of a fibre box,

other than the tape, is silicate of soda. The importance of this material will be realized when it is stated that many factories use 100 tons or more of it per week. The adhesive properties of this substance vary considerably in different lots and some sort of laboratory control often is desirable to secure the best results. A laboratory which is equipped for this sort of work can make very quickly a report on these essential properties.



"Drum" Box-Tester to Determine Behavior in Use of Fibre Containers, Mellon Institute of Industrial Research, Pittsburgh, Pa.

Salt Saves Silicate

During one of the recent freight tie-ups, the stocks of this adhesive at many plants began to run dangerously low. This laboratory was given the problem of devising some method for increasing the volume of the water-glass without injuring any of its essential properties. The problem finally was solved by allowing the adhesive to react with brine. This method involves a practical application of colloid chemistry, and offers an economical means for increasing the volume of the original water-glass to the extent of 25 per cent., without impairing any of the desirable qualities. This method has been described elsewhere^a at length.

In spite of its universal use in this industry, silicate of soda possesses some properties, such as free alkalinity for instance, which are disadvantages. Constant experimental work, therefore, is under way in search of a better adhesive. Many sources of cheap, yet efficient, substitutes have been investigated, as, for instance the waste liquors from the sulfite paper pulp process. Corn-cob adhesive is another promising sub-

^a"A Colloidal Method for Increasing the Volume of Adhesive Water-Glass," *J. Ind. Eng. Chem.*, 12 (1920), 174

ject for research. This adhesive is the invention of Dr. F. B. LaForge of the United States Department of Agriculture and has the advantages of cheapness and absence of free alkali.

Waterproofing

Another application of chemical research to this industry is the study of waterproofing compounds. At present, container board is sized with rosin, which is precipitated on the paper fibres in the beater by the action of alum on rosin soap. This waterproofing of a board sometimes is destroyed partially by the tendency of the free alkali in the adhesive to penetrate the board and saponify this rosin. Attempts are be-

ing made to correct this occasional trouble by developing unsaponifiable sizing agents, as well as neutral adhesives.

An Example to Industry

These, then, are the more important points upon which industrial research can be of assistance to the fibre container industry and eventually, therefore, to the public. Such investigations, to be of most value, should benefit the largest possible number of industries. This can best be accomplished by trade organizations, of which the Container Club is a representative, rather than through the private laboratory of any one firm.

American Cyanamid Company

Frank S. Washburn, president of the American Cyanamid Co., in his statement of the activity of his company for the fiscal year ending June 30, reports the income account for the past three years as follows:

	1919-20	1918-19	1917-18
Gross sales	\$8,464,389	\$5,612,963	\$5,537,077
Freight allowances	325,421	67,840	39,569
Net sales	\$8,139,468	\$5,545,123	\$5,547,508
Sales to Amalgamated Phosphate Co.	\$44,617	660,263	647,160
Total sales	\$8,684,085	\$6,205,386	\$6,194,668
Cost of sales	6,611,196	4,158,704	3,548,284
Selling and general expenses	356,528	473,640	301,148
Net profit on sales	\$1,716,361	\$1,573,041	\$2,345,236
Income on sub. charter of steamship	\$60,015		
Miscellaneous income	34,479	\$11,152	\$35,472
Profit on manufacture of cyanide		49,510	\$5,848
Interest, exchange and discount earned	281,322	148,706	41,052
Royalties on nitrogen		15,721	
	\$2,092,177	\$1,798,130	\$2,507,608
Interest, exchange and discount paid	\$4,115	\$6,349	\$7,448
Int. on bonds of the Amal. Phos. Co.	57,617	61,042	64,800
Loss on commissary operations		1,149	
Loss on sale of Liberty & Victory bonds	6,750	61,357	
Technical department expense		46,754	
Net profit year Am. Cyanamid Co.	\$2,023,695	\$1,621,489	\$2,435,360

The operation of the cyanamid plant at Niagara Falls has been at full capacity for the entire year. The two new and improved carbide furnaces, of a capacity in excess of the eight old furnaces which they replace, were completed during May, and in economy and efficiency have fully met expectations.

Operation of the Ammo-Phos plant at Warners, New Jersey, was less than capacity, due to interruptions in deliveries of materials; but on the whole has done well. For the past six months the production of ammo-phos, in order to meet trade demands and market conditions, has been confined to a new grade of material containing approximately 20 per cent. ammonia and 20 per cent. available phosphoric acid.

J. N. Gunn, vice-president of the United States Rubber Company, authorizes the statement that the new tire manufacturing plant of the United States Rubber Company at Hartford, Connecticut, a part of the company's tire extension program begun two years ago, has reached a sufficient state of completion to enable the company to start manufacturing there with three eight hour shifts. Three lower floors of the building are entirely completed. It will be devoted entirely to the manufacture of cord tires. The first pencil sketch of this new building was not drawn until August 2, 1919, and ground was broken in October. The new building has seven floors and a total floor area of 278,000 square feet.

Operation of the phosphate mines at Brewster, Fla., was seriously interfered with for six months by the walk-out of employees. For the past six months, however, normal output has been attained and even exceeded.

The market demand for all our products has been materially in excess of the supply; and the larger part to be produced during the current output has been attained and even exceeded.

The market demand for all our products has been materially in excess of the supply; and the larger part to be produced during the current fiscal year has already been contracted for at profitable prices.

During the year the company acquired ownership of a half interest in the Owl Fumigating Corporation. This company was formed primarily for the purpose of manufacturing and distributing liquid hydrocyanic acid made from "Aero Brand" cyanide produced at the Niagara Falls plant. This company recently constructed a plant in the town of Azusa, Calif., in the centre of the citrus fruit district. The output is to be used in the fumigation of citrus trees. This development promises to be a profitable one in itself, and also provides an outlet for a substantial part of the cyanide manufactured at Niagara Falls. The entire process is covered by United States patents, and patents either have been or are being secured in certain European countries.

"Aero Brand" cyanide which is the trade name given the product manufactured from cyanamid, is now used in every important gold and silver mining district in the United States, and also in many similar districts in Mexico and Canada.

On June 30, 1920, we had on hand contracts for delivery prior to June 30, 1921, of various products estimated to have a sales value of approximately \$7,000,000

Application has been made to the Saskatchewan provincial government for the incorporation of the Ceylon Sodium Sulphate Co., to develop the sodium sulphate deposits south of Ceylon, Sask. The men seeking incorporation are: John W. Irwin, Estlin; Fred D. Whitworth, Hardy, and John D. Burns, Moose Jaw, Sask. The deposits contain large quantities of exceptionally pure sodium sulphate.

* * *

Essential Oils Co., of Philadelphia, Pa., will erect at Bogalusa, La., a plant for the recovery of resin products from pine stumps and light wood and from cuttings from local mills of the Great Southern Lumber Co.



View of Industrial Village, The Viscose Co., Marcus Hook, Pa., from Dining Hall and Recreation Building.

Housing Development of the Viscose Company

By Emile G. Perrot

The Viscose Co., manufacturers of artificial silk, with plants at Marcus Hook, Pa., and Roanoke, Va., is one of the pioneers in the practical application of the principle that home surroundings are a strong factor in the contentment of employes.

The necessity of good housing accessible to the plant was emphasized during the war. While the require-

ments of munitions production necessitated plant construction often remote from established civic and shopping centers, the practical aspects of employe relations of this character have a peace time precedent, with varying degree of success, dating from the Pullman project down to the present temporary discouragement arising from economic conditions in the building trades and industries.

While humanitarian ideals may play their part in the development of modern housing projects, experience has shown that the further the plans fall from recognition of the independence of the employe the less creditable and less successful the venture in its influence upon satisfactory working relations.

The character of housing reflects generally the character of the employe and the nature of his employment. The English industrialists were the forerunners in showy practical solicitude for the domestic conditions of the employe and helpful provision for his leisure, and have stamped their influence upon such projects architecturally and otherwise.

The rapid changing industrial conditions of America have compelled close study of every influence affecting stability of employment with the result that the future will see more of the decentralization of manufactur-

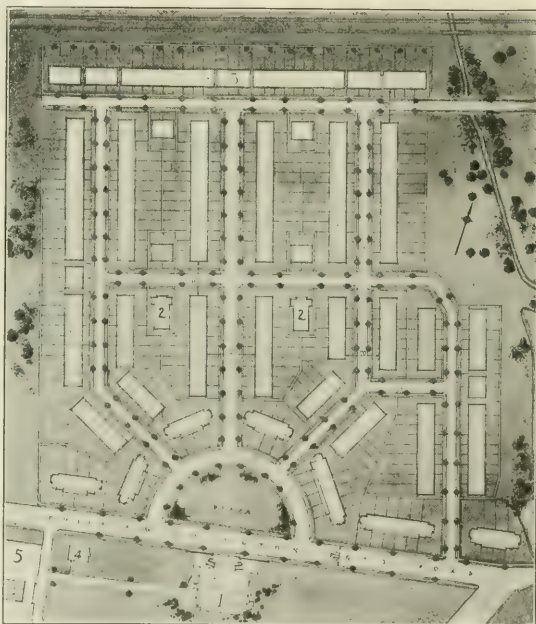
ing activities with consequent necessity of such investment as is here described than has marked past recent industrial history.

Unlike the model suburb, which aims to remove itself far from the din of the factory or city noise, the industrial village becomes an adjunct to the plant. It is this proximity that makes the problem more difficult of solution, for there must be considered aspects not occurring in the model suburb, which is free from any influence of the factory.

Heretofore, the demand for houses has been supplied by the speculative builder and the real estate operator. Owing to the present abnormal prices of labor and building materials, they can no longer afford to build and sell at a profit in the open market. The manufacturer is confronted with the certainty that industrial housing to meet his needs, will not be financed by local investors as in former years. Speculative builders rarely meet his real needs anyway, as they had their eyes on profits and never glimpsed the real aim of industrial housing, which is better workmen, better satisfied.

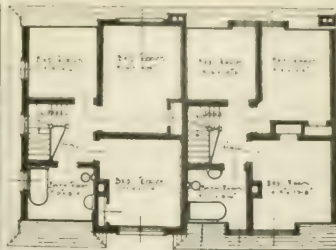
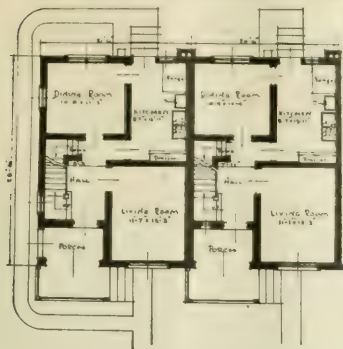
The character of the character of their work. Ramshackle dwellings bring forth ramshackle workers. Beautiful factories, modern machinery, intricate processes and uninspiring surroundings of the workers' life form a weak combination. Houses alone are not a cure-all for industrial ills, but the force of this influence is felt today as never before.

The growth of the Viscose Company's business was so rapid that the demand for help exceeded the supply of the immediate vicinity. It managers found it neces-



PLAN OF THE VISCOSSE CO. INDUSTRIAL VILLAGE.
Ballinger & Perrot, Philadelphia, Pa., Architects and Engineers

1—Dining Hall and Recreation Building. 2—Boarding House.
3—General Store. 4—Dispensary 5—Main Factory Building.



Six-Room Cottage, Viscose Industrial Village.

First Floor Plan.

Second Floor Plan.

sary to provide housing facilities for the increasing number brought in, which effort took shape in an industrial village located at Marcus Hook, upon a tract about twenty acres, directly opposite the plant, which is on the main highway between Chester, Pa., and Wilmington, Del.

The village comprises at the present time 260 dwellings, two boarding houses, a village store, and a dining hall and recreation building, which accommodate a large portion of the employees.

The Viscose Company expresses itself as well satisfied with results. Rents are reasonable to the degree that direct financial returns on the investment are impossible.

The company did not have these in mind when it established the village. Returns in the form of contented help of a highly efficient character have more than repaid for the efforts made. As a result, a selected class of high grade workers which is required in the operation of the intricate processes involved in the manufacture of the company's product has been attracted. The employees occupying the houses take a pride in aiding the management to develop and maintain the attractiveness of the village.

Instead of following the stereotyped style of rows of two-story brick houses, which is common for workingmen in the mill districts of Philadelphia, near which Marcus Hook is located, the problem has been considered not from a commercial standpoint, but from the standpoint of what best suits the character of the people employed.

As the houses are not sold to the occupants, the entire estate being under the control of the company, the consideration of the aesthetic entered as much into the planning of the village as the disposition of the rooms in the houses, so that instead of having a village with

rectangular plots and uniform rows of houses, streets diverging from a central plaza, with beautiful vistas, are the outcome. Several types of houses have been designed, with a view to accommodating the varying wages of the working people.

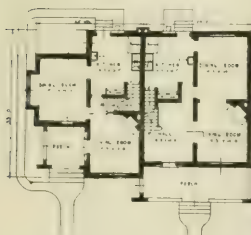
In general, there are two classes of houses, of eight and six rooms, respectively, the price for the larger houses being a trifle more than for the smaller houses. The houses surrounding the semi-circular plaza, of course, are the larger and more expensive from the standpoint of construction and artistic appearance, and are occupied by the better class of employees. Those in the streets diverging from the semi-circle are less expensive. The architectural treatment of the facades of the houses on each street is different.

No house has less than three bedrooms on the second floor, together with living room, dining room and kitchen on the first floor. This permits the occupant of the house, where there is a small family, to have separate rooms for sleeping. A modern bathroom and front porch are provided in each house.

The customary outside wooden shed, which is so common, is omitted, the back of the houses being treated architecturally with the same care as the street fronts. The customary side yard also is omitted; the houses being made purposely broad, joining each other and made two rooms deep. The lighting of the rooms is from the front and not from the sides, except in the case of the corner houses.

The materials of construction are of the best. All the walls are of brick, the roofs of slate, and the porch floors are of cement.

All the houses have cellars, are provided with water and gas, and each has an independent hot-air heating system. The fronts of the houses are terraced above the street, and rows of trees are planted on each side



First Floor Plan.

Second Floor Plan.

Special Six-Room (End) House and Eight-Room House, Viscose Industrial Village.

of the streets. Hedges divide the lawns in front of the houses; and low iron fences separate the back yards from each other.

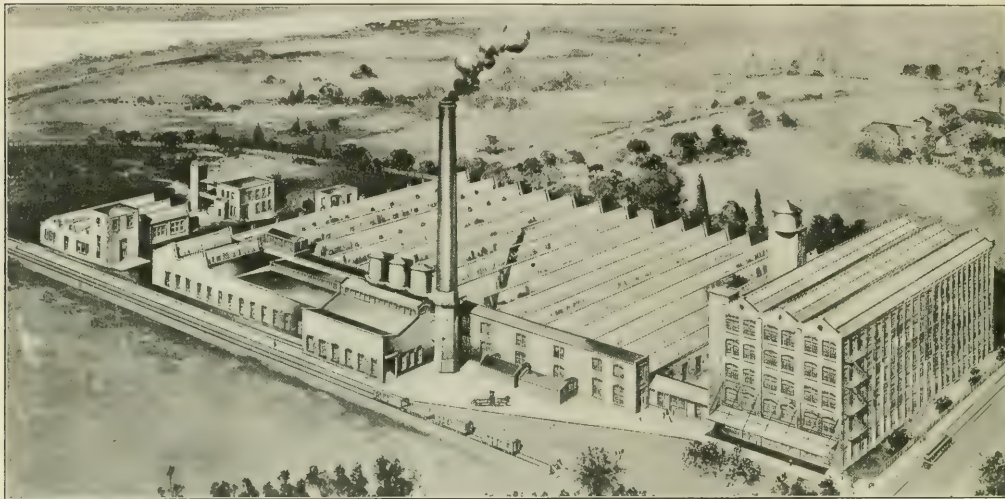
Sewers of the most approved types have been provided for the entire property, separate storm and soil sewers being installed. The streets are macadamized with cement curbs and gutters. Cement sidewalks are provided with grass plots on each side. The large semi-circular plaza is treated as an open lawn and ornamented with shrubbery.

The village store, run by the company on the co-

proof construction.

The ground story is used for men's dining room, toilet and cloak rooms, food preparation and store-rooms. The first story contains the women's dining room, with sewing room and rest rooms in connection therewith. The first story is used for recreation purposes and for entertainments. A roof garden is also provided on top of the building with floor of promenade tile.

In constantly increasing numbers, good workmen today are refusing to live under indifferent conditions.



View of Plant, The Viscose Co., Marcus Hook, Pa.

operative plan, is located at the end of the central street. The two boarding houses are located near the center of the village.

On the opposite side of the main road from the semi-circular plaza of the village is the dining hall and recreation building, which is also intended to be used for public entertainments, social occasions, as well as general recreation purposes. The building has a frontage on the main road of 104 feet and a depth of 85 feet and is two stories in height. It is constructed of brick with stone and terra cotta trimmings, and is of fire-

If one manufacturer will not provide suitable living facilities, they will seek one who will. The day is coming when the manufacturer will have to compete not only in wages, but in living accommodations as well. The large labor turnover, due largely to shifting population, resulting in the so-called "floater," is due often to inadequate, unsanitary housing.

Model villages are beginning to spring up in industrial centers, as one manufacturer after another is brought to a realization of the absolute necessity of such adjuncts to well-rounded manufacturing enterprise.

Certain-teed Products Corporation

Certain-teed Products Corp., St. Louis, Mo., has purchased the entire capital stock of Thos. Potter Sons' Co., Philadelphia, Pa., manufacturers of floor coverings, oilcloth, etc. William Potter, former United States Ambassador to Italy, will, under the new arrangement, become a member of the Board of Directors of the Certain-teed Corporation and Joseph W. Wear, treasurer of the Potter Company, will be vice-president of the Certain-teed Corporation in charge of that department of the business. Annual sales of the Potter company have been in the neighborhood of \$6,000,000.

The Thomas Potter Sons' Company was established in Philadelphia in 1837. The plant, which is an ex-

tensive one, is located at Second street and Erie avenue. The capital stock of the company is reported at \$800,000 and the transaction involved more than \$3,000,000. William Potter, Charles A. Potter, vice president, and Joseph W. Wear, secretary and treasurer of the company, comprise the board of directors.

The Certain-teed Products Company, which embraces the Paint & Color Company of Missouri and the General Roofing Manufacturing Company of Illinois, was incorporated January 30, 1917, in Maryland. It manufactures and distributes prepared roofings, building papers, felts, paints, varnishes and kindred products. It has plants at York, Pa.; Marseilles, Ill.; Richmond, Calif.; St. Louis, Mo., and Niagara Falls, N. Y. Distributed about the country are thirty-six sales offices and forty-nine warehouses.

The Money Value of the Humanitarian Impulse In Industry

By Clark Belden

The Travelers' Insurance Company

The man who must work and the man who must find work for that man to do should be bound by ties that are stronger than mere wages.—Thomas Carlyle.

If justice demands this, its cost is a fair charge against the business, and we so regard it.

—Theodore N. Vail.

HUNDREDS of years ago in Europe the nobleman or business man who employed labor cared for the families of his workers if anything happened to the worker himself. In return for years of faithful service the worker had the assurance—should he die or be disabled—that his family would be helped by his employer. This humane custom of old illustrates the personal connection that exists between the employer and his workman wherever the most satisfactory results are obtained.

Today in America manufacturers and merchants employ many times the number of men that were employed on one estate or by one merchant in the Middle Ages. Consequently it is difficult today to retain the personal connection that once existed between the head of an establishment and his workers. Yet it is vitally necessary for satisfactory results that this close liaison continue to be maintained. "You can buy a man's labor but you must cultivate his good-will." How can this be done successfully?

What Is Group Insurance?

America has found the answer in group insurance—life, accident and sickness. Group insurance might be termed a personal representative, acting for the employer and reaching to the most remote corner of his organization, however large.

Through group insurance every last man in an establishment—even if there are 50,000 workers—realizes the personal interest of his employer in his family and himself. Group insurance is the cementing bond in the large concern of today. It increases the self-respect of the most humble worker, helping him to realize that he is not a submerged non-entity.

When death and disability claims arise under group insurance they are usually handled by a committee of workers themselves. Many employees thus see the value of group insurance in a first-hand manner and naturally spread their favorable opinions among their fellow-workers. Families saved from hardship, and workmen whose disability expenses are paid through group insurance are the best of advertisements for the good that the plan actually does. Each claim paid helps to create additional good-will.

Group Insurance Explained

Group life insurance covers 50 or more employees under one blanket policy at a low premium and without individual medical examination. The cost usually ranges from two to three cents a day for each employee, depending upon the plan of insurance adopted. Individual certificates are issued to each employee covered, and the protection ceases when the employee terminates his employment, unless he takes advantage of his privilege to convert the group insurance to a life or endowment policy.

Through group life insurance the family receives a definite sum when a workman dies. This plan, which has proven most satisfactory, provides for a sliding scale of benefits, based on length of service. The minimum is usually not less than \$500, with an increase of

\$100 or more for each year of continuous service up to a maximum of \$2,000 or \$3,000. For instance, if an employee of 3 months' service died, his family would receive \$500, whereas, if an employee of fifteen years' service died, his family would receive \$2,000. This rising scale of benefits favors the older employee and puts a premium on length of service. This has a tendency to reduce labor turn-over. It is a reward for continued service.

Group accident and sickness insurance reimburses the employee for loss of time sustained through accident or illness. The indemnity here may be a percentage of the employee's average weekly wage or a specified uniform amount of all employees. Group accident and sickness supplements group life insurance and gives the employee a well-rounded protection.

An important advantage of group insurance is that it gives accident protection outside of a man's working hours—while he is exposed to the hazards of the everyday world. Compensation insurance affords protection only during working hours. Group accident insurance covers the other hours of the day; and group sickness insurance covers all hours.

What Group Insurance Does

There are many arguments in favor of group insurance. It is doubtless true that this insurance helps to reduce labor turnover, that it creates good-will, that it attracts capable employees, that it provides an incentive to initiative, that it saves money for both employer and employee, that it alleviates distress among employees and their families, and that it helps to retain skilled workers.

But there is another factor which alone and in itself is the real *raison d'être* for group insurance. It is well known that a man's efficiency and productive ability are governed closely by his mental state. The psychological effect of anxiety upon the worker is too generally known to need comment. Some of the thoughts that persist in every man's mind are the fear for his family in case of his death, and fear for himself in case of accident, sickness, permanent disability or old age.

Psychological tests have shown that such fears as these constantly running through a worker's mind reduce his output as much as 15 per cent. or more. Otherwise capable workers are often only 85 per cent. efficient for this reason alone. Group insurance largely sets at rest these fears because it provides definite financial help when a family has been robbed by death or disablement.

Thus group insurance helps to increase production by freeing the employees' minds of these fears. It raises the efficiency of each individual and thus of the entire organization by helping to furnish a contented outlook.

The Worker's Wife

Perhaps the person most directly concerned about group life insurance is the worker's wife. She knows that she will have to provide for the children and for herself if anything happens to her husband. Conse-

quently, she, more than anyone else, appreciates this protection. Now most men talk over important decisions with their wives. For instance, if any employee is considering taking a new job, group insurance may figure prominently in the decision.

If a man had \$1,000 of group life insurance to his credit and the concern which he planned to join had no group insurance, his wife would be more than likely to insist that he retain the old job because \$1,000 in time of need would mean much to her. Again, if a man had been with a factory for fifteen years and had \$2,000 of group life insurance to his credit, and he were thinking of joining a nearby factory which also had group insurance his wife would be quick to appreciate the reduction in insurance and undoubtedly would try to persuade her husband to remain in his original position.

Testimonials of the Efficiency of Group Insurance

This tendency of group insurance to hold employees often is illustrated. The president and manager of a southern newspaper wrote a prominent insurance company recently concerning the favorable results of a group policy. He said:

"We have had group insurance in operation a little more than a year and it has proven satisfactory. I know of one instance in the past year where the insurance turned the decision of the employee to stay instead of going. As the wife was the controlling factor she realized there was something she would get since a responsible house paid the insurance premiums.

"The women folks of the wandering gentlemen suffer most by the constant change in location, and the insurance feature is something they appreciate. I think the insurance helps to stabilize the employee."

Group insurance is a recent form of insurance. It was perfected about five years ago because of the increasing realization of the need of a closer bond between the head of an organization and his employees. It has grown rapidly during the last two years and is being widely adopted by far-sighted employers everywhere.

At the end of 1919 more than one billion dollars of group insurance was in force in this country, covering over one and a quarter million employees in many different industries. The figures for 1920 will show a substantial increase.

Perhaps the reason for its widespread introduction is best expressed by the sentiments of the late Theodore N. Vail, president of the American Telephone & Telegraph Company. Many other far-sighted employers hold views similar to those expressed by President Vail, who said:

"The benefits under our plan are not required by law, but we believe it is no more than simple justice that the men and women who devote their working lives to the telephone service should be assured of some income when they are sick or come to old age, and that some immediate provision should be made for those dependent upon such workers when they die in the service. If justice demands this, its cost is a fair charge against the business, and we so regard it."

Employers of labor who have become nationally known by their writings on the various phases of the labor situation, such as W. A. Gries, secretary of the Jeffrey Manufacturing Company, and Paul Feiss, president of the Joseph and Feiss Manufacturing Company, of Cleveland, and president of the Cleveland Chamber of Commerce, and a member of the conference called by President Wilson for the discussion of the relations between the employer and employee, concur in this opinion expressed by Mr. Vail.

The Manufacturers' Association of Canada has

recommended group insurance for the employees of Canadian industries. John Kirby, long time president of the National Association of Manufacturers, has endorsed group insurance and adopted it for the employees of his enterprise, the Dayton Manufacturing Company.

A state insurance commissioner declared recently that the insurance companies selling group insurance were doing "a public service second to none."

Group Insurance in the Chemical and Allied Industries

How does group insurance relate especially to the chemical and allied industries? In general the advantages above outlined apply as strongly in the chemical industries as in other industries. Group insurance is not limited in value to a few industries only.

It has a specific application to the chemical industries, however. Employees in general may feel that some of the chemical industries present working conditions that are slightly more dangerous than some other industries. This viewpoint, whether or not it is founded on fact, may work to the detriment of a free supply of labor in the chemical industries. It might afford an inducement for chemical employees to seek other industries as a means of protecting their families and themselves against these supposed extra dangers.

How better could this viewpoint be offset than by providing group insurance and consequently a double working protection, i. e., both compensation and group insurance? This double protection would assure chemical workers that their families and they themselves were protected adequately at all times, whether at work or off duty. Such care taken for their welfare could not but help to overcome any misapprehensions as to their future. It also would help to discourage any inclination among older chemical workers to change their employment. Considering the high cost of training new employees, which often runs into the hundreds and sometimes into the thousands, a considerable expense is thus saved to the employer on turn-over.

Group insurance would thus help to stabilize the labor problem in the chemical industries, attracting new and holding older employees; it would tend to raise the individual output by increasing working efficiency through the removal of family and financial anxiety; it would save chemical workers thousands of dollars in medical bills yearly, and it would help dependent families through the first few critical months after their wage earner's death.

The many advantages accruing through group insurance to the employer, to the employee, and to the industry, would probably more than offset the moderate cost. In a word, the benefits are many and important to all affected; the cost is relatively small.

We have given the sentiments of prominent and far-sighted employers on group insurance. What do the employees themselves think of it, and what do their various house organs say about it?

Testimonials and Examples

The *National Lamp News*, an employees' magazine of the General Electric Company, recently made these pointed remarks on group insurance:

"Everyone knows that his or her death or disability means an added burden to someone—mother, father, son, daughter, sister or brother, wife or husband. Someone must be cut off from help they had been accustomed to receive, and usually put to immediate added expense. Because of this knowledge and the desire to spare dependents all the pain possible, have arisen the almost universal wish for life insurance. But for many it has been

beyond reach because of cost, while some have been unable to procure it because of physical condition. Those of us who were barred from its benefits in the past because of those reasons are now protected."

The *Rubber Leaf*, an employees' magazine of the McGraw Tire and Rubber Company, recently emphasized the value of group protection as follows:

"Far greater benefit is derived by the man who stays in one place than by the floater."

"Many families are protected against that time when the bread-winner may be taken away."

"That the expense it would cost each employee to carry the same amount of insurance with another company is a fact to be considered in connection with our present work."

Employees of the Jeffrey Manufacturing Company recently had a dinner, at which they approved the adoption of group protection as follows:

"Insurance protection is something every man, woman and child should have. Frequently physical infirmity does not permit of insurance being secured. In a plan adopted by the management and co-workers these possibilities have been taken care of. It matters not whether you have physical infirmities. Since the plan was announced there has been a constant expression of approval and appreciation on the part of the co-workers."

On May Day of this year the employees of the American Woolen Company at Lawrence Mills showed their appreciation of group insurance by sending a committee to the president of the company. The *Boston Transcript* described the occasion as follows:

"Accompanied by a committee representing the different nationalities among the 6,200 employees of the Wood Mill in Lawrence, Walter M. Lamont, agent of the mill, today went to the home of William M. Wood, president of the American Woolen Company, in Andover, and at the request of the men presented to Mr. Wood a testimonial in the form of an engraved resolution. The resolution thanked Mr. Wood for his continuous personal interest in the welfare of the employees, especially with reference to furnishing life and health insurance and the establishment of the cooperative store for the American Woolen Company's employees in Lawrence. Mr. Wood was deeply moved, and thanked his visitors for their kindness. Thus May Day for the thousands of workers and this mill marked more harmonious relations, instead of open demonstrations of dissatisfaction."

What does the widow of the dead employee have to say about group insurance? Here's a typical reply received by a large factory:

"I take pleasure in thanking the Chase Companies for their kindness and sum of insurance, which has and will, in the future, help me and my two little children. I also wish to thank those who have been interested in my husband. This insurance is a good thing; it helps those who are left to fight for the children. It sure helped me in my hard luck. I hope to work some day for the company and become one of the insured."

It is well-known that the certificate issued to each employee covered by group insurance is highly prized in the family and is often framed and hung in a place of honor, where it is a constant reminder of the service that group protection stands ready to afford any time that it is needed.

Who does not recall the practice of "passing the hat" to help some struggling family? In many working places this system is a constant drain on the good nature and purse of the workman. Often money needed by a man's own family goes in this way to support a dead workman's family. When we recall that forty per cent. of employees carry no life insurance whatever, and the other sixty per cent. carry but a small amount, the necessity of some kind of help for these dependent families is evident. But why force the employees themselves to contribute this money when group insurance will do it so cheaply and so promptly? Then, too, several times as much money can be furnished in this way to each family than by "passing the hat."

Employees do not fail to appreciate the removal of this constant source of expense to them and the handling of the matter in a business-like manner, through group insurance, which does not cost them one cent.

Here are some of the progressive concerns in the chemical field who have taken out group insurance contracts with our company:

Atlantic Dyestuff Co., Boston, Mass.; J. T. Baker Chemical Co., Phillipsburg, N. J.; Brunner Mond Canada, Ltd., Toronto, Ont.; Central Commercial Co., Chicago, Ill.; Dicks, David & Heller Company, Chicago Heights, Ill.; Furst-McNess Co., Freeport, Ill.; The R. M. Hollingshead Co., Camden, N. J.; Iliff Bruff Chemical Co., Hoopeston, Ill.; Katzenbach & Bullock Co., Trenton, N. J.; Lehn & Fink, Inc., New York, N. Y.; The Mendelson Corp., Albany, N. Y.; North American Chemical Co., Bay City, Mich.; Norwich Pharmaceutical Co., Norwich, N. Y.; Rohm & Haas Co., Philadelphia, Pa.; Solvay Process Co., Detroit, Mich.; The Upjohn Co., Kalamazoo, Mich.; West Disinfecting Co., New York, N. Y.

Textile Alliance, Inc., to Supply German Dyes

Following upon the rulings of last July of the War Trade Board section of the State Department, whereby individual import licenses from enemy countries were dispensed with, save for a comprehensive list of coal tar chemical products embracing synthetic drugs, intermediates and dyestuffs, etc., and these only when satisfactory domestic substitutes are not obtainable on reasonable terms as to price, quality and delivery, are the rulings promulgated Sept. 2, whereby the Textile Alliance, Inc., 45 East 17th Street, New York, is authorized to undertake without profit to itself, the purchase and sale, under fair and equal conditions of distribution, to American dyestuff consumers, certain dyes comprising, (1) the final apportionment of impounded stocks covered by inventories of German dye-makers as of August 30 and Sept. 5, 19 and 27, 1919, and (2) selections from existing German stocks made between February 28-June 30, 1920.

If found necessary and advisable Textile Alliance, Inc., is authorized to continue purchases from German future productions for a 4½-year period beginning July 1, 1920, under the conditions above set forth.

The consumer should clearly understand that he is not obligated or even advised to place orders through the machinery made available by the government. If he believes that German dyes may be obtained from unofficial sources, he may, subject to the then existing import regulations, either order such dyes as he needs direct from the German manufacturer or through such agent or agency as he may designate.

If the consumer, however, cannot obtain or believes he cannot obtain dyes by other means, the government can exercise its option on the subsequent daily production of the German factories and the Textile Alliance, Inc., can transmit his orders for purchase from official sources.

Beet Growers Would Have Sugar Mills—Many Factors First to Be Considered

By W. A. Taylor

Chief, Bureau of Plant Industry, U. S. Department of Agriculture.

KEEN interest is being evidenced by sugar-beet growers in various sections of the country in the possibility of producing their own sugar on the farm by some simple process or of establishing and operating their own sugar mills. Owing to the scarcity and high price of sugar numerous inquiries on the subject are being received by the Bureau of Plant Industry of the United States Department of Agriculture.

Beet Sugar Production Not a Household Industry

According to specialists of the Bureau who have made a close study of all phases of beet-sugar production, there are several fundamental features to be taken into consideration in the establishment and operation of sugar mills. In the first place, no simple or inexpensive method of making sugar from beets on a home community scale has been devised.

It is true that the important substitutes for sugar, such as cane, sorghum and beet syrup, can be made in the home or on a small community scale with comparatively simple and inexpensive equipment, but in making beet sugar none of the important steps can be omitted nor can they be carried through profitably except on a comparatively large scale. Therefore a fully equipped sugar mill is necessary in producing sugar from beets. The smallest beet-sugar mill to be successful should slice not less than 500 tons of beets a day for a period of 100 days each year.

Historical

The first practical attempt to establish a beet-sugar industry in the United States was made at Northampton, Mass., in 1838. The total output of this mill for the season was only 1,300 pounds of sugar. It was necessarily a financial failure, but it demonstrated that American soil, American climate, and American skill and industry could produce beet sugar. During the next forty years a dozen attempts were made to produce beet sugar commercially in the United States, but none of the mills erected had a capacity of over 100 tons of beet roots per day and the working capital was small. Consequently the operating costs exceeded the profits and each of these small projects quickly failed.

The first commercially successful beet sugar mill erected in the United States was built and operated in 1879 by E. H. Dyer, of Alvarado, California, but not until Mr. Dyer had experimented for nineteen years and experienced four failures. Originally this mill handled but fifty tons of beets per day, but its capacity has been increased to 800 tons. Of the first twenty-five beet-sugar mills erected in this country twelve were not able to handle as many as 500 tons of roots per day, but all these small mills have had their capacities increased or have ceased to operate. The point is that the operating expenses of the small mills are larger in proportion to the out-turn of sugar than are the operating expenses for the larger mills. Hence, under normal conditions the smallest mill which is reasonably safe as an investment should be able to handle 500 tons of roots per day and should operate at least 100 days annually.

Beet Yield, Acreage and Proximity to Mill

Since the average yield of beets in the United States is ten tons per acre, not less than 5,000 acres of beets must be grown annually for each mill of this size. A smaller acreage would probably cause the mill to operate at a loss under normal conditions. While the sugar beet is resistant to adverse conditions, there is almost always a larger or smaller loss of beet acreage during the season in every community where beets are grown, hence, in order to bring 5,000 acres of beets to maturity it would be wise to plant from 5,500 to 6,000 acres. It is entirely practicable for a beet-sugar mill to operate more than 100 days, providing the raw material is available, and the profits from the longer run will be correspondingly larger.

In order to insure an annual planting of from 5,000 to 6,000 acres of beets in a given area there should be available in that area at least from fifteen to twenty thousand acres of good beet land so that proper crop rotation could be practiced. This acreage should be so located that from 25 per cent. to 50 per cent. of the beets grown can be delivered at the sugar mill by wagon and the remainder of the beets should have a freight haul of less than 100 miles, in order to avoid heavy freight charges. While the sugar beet is no harder upon the land than are the other field crops, good farming demands that a well-planned rotation be practiced in order to avoid the ravages of pests and in order to obtain the best yields of all the crops in the rotation system.

Beet-Sugar Mill Costs and Essentials

The construction and equipment of a mill of 500 tons slicing capacity would cost under present conditions approximately \$1,000,000. This is about 100 per cent. above pre-war costs, owing to the increased price of materials and the higher scale of wages. In addition to the initial cost of the mill approximately \$500,000 of working capital would be required in cash for overhead charges and operating expenses until returns can be expected from the sale of the sugar. The larger mills will require a correspondingly larger initial outlay, but the operating costs of the larger mills will not be as great per ton of sugar produced.

There is a maximum capacity of mill for each locality and some financial failures have been due to the fact that 1,000-ton mills have been built to serve communities which could have been served as well by smaller mills and consequently by smaller investments. In establishing beet-sugar mills, therefore, the proper balance between size of mill and the probable supply of raw material must be kept in mind.

Probably the most important of the other items to be taken into account in the operation of a beet-sugar mill is that of a supply of sugar-beet seed. A 500-ton mill would require about 100,000 pounds of seed annually to insure the production of sufficient beets for a 100-day run. Sugar-beet seed of good quality has been produced in the United States each year for several years, and those who are considering the erection of beet-sugar mills should look into the possibilities of pro-

ducing their own seed. This minimum-sized mill would require, in addition to its permanent employees, about 300 workmen for the operating period and a good supply of pure water, high-grade lime rock, and plenty of coal for fuel, besides numerous other supplies.

Origin and World Status of Beet-Sugar Manufacture

In regard to the origin and development of the beet sugar industry in the world, the first commercial output of beet sugar was produced in France in 1812-13 and amounted to only 3,850 tons. Just one hundred years later, 1912-13, the world's production of beet sugar reached its maximum of 10,053,423 tons. This was approximately 50 per cent. of the world's produc-

tion of sugar from both beet and cane, which amounted in that year to 20,393,871 tons. At that time, 1912, there were more than 1,200 beet sugar mills in the world, and the present world shortage of sugar, amounting to more than 3,000,000 tons, is due almost entirely to the destruction of hundreds of these mills, to the shortage of labor and to other economic causes.

Within the United States the beet sugar industry, which was established in 1879, has increased until sugar beets are now grown commercially in seventeen states, more than 100 mills with an average capacity of nearly 1,000 tons of roots daily have been erected, more than 900,000 acres of beets have been planted for this year's crop, and nearly a million tons of beet sugar should be produced in this country this year.

Heavy Chemical Merchandising in the Post-War Period

By Guy A. Gardner

Manager, Chemical Department, M. Gottesman & Co., Inc.

A REVIEW of merchandising in the heavy chemical market since the signing of the armistice on Nov. 11, 1918, to the present time, must of necessity read like the review of the situation in all the leading commodities of American manufacture, as there is scarcely an industry of any magnitude in which chemicals are not employed to a greater or lesser extent.

Prior to the armistice due, of course, to war conditions, the general market was high with a trend towards still higher prices caused by an active demand for practically all industrial chemicals, some of which were unobtainable, and the use or sale of most of the others, restricted by governmental action.

The first and immediate effect on buyers of the preliminary peace agreement of November, 1918, was a cautious attitude brought about by the belief that as actual fighting was over and the demands of war were no longer in competition with the needs of peace, production cost would decline and prices would decrease rapidly. This situation was of temporary character, but a period of several months elapsed before the consumers came to realize that the prosperity of peace, replacing the waste of war, took up all available supplies, that production costs were increasing instead of diminishing and that a world-wide demand existed for America's chemical output. These factors and a lessened production in many lines soon indicated that prices would not only stay high, but must necessarily go higher.

The railroad, reduced to a state of inefficiency through the privations of war and war management, could not adequately handle the great traffic which peace and prosperity brought. Production suffered thereby. Labor difficulties were experienced by every industry, particularly in steel and transportation. The relation of these two factors to the chemical industry cannot be overlooked. Production was materially reduced and the output of many important industrial chemicals suffered. Transportation difficulties not only retarded the arrival of much needed material at the consumer's plant, but in a most serious degree hindered delivery to the chemical manufacturer of essential elementary raw materials.

The impelling cause for the great advance in prices which then took place in caustic soda, soda ash, bleaching powder, alum and the various soda salts, other than

the difficulties of manufacture, was a renewal during the early spring and summer months of 1919 of the export demand for many industrial chemicals which demand has kept up practically to the present day.

Many countries which in the past depended on England and Germany for supplies have been large and constant buyers in the American market, and have paid such attractive prices that the domestic buyers have been compelled to bid for their needs. South America has greatly increased its purchases from us. Japan, until recently when financial disturbances in that country lessened its buying power, has used large quantities of American-made chemicals. Europe, too, suffering from the impairment of her manufacturing facilities as a result of the war, instead of as previously being a competitor for the world's trade, became a buyer and joined, as it were, in the scramble with the rest of the world to buy what we had to offer in chemicals.

Our own industries, other than the manufacture of chemicals, enjoying a great volume of prosperity, have required greatly increased tonnage of all heavy chemicals and their uses of these materials have so increased as to tax the facilities of our factories to their very utmost. Naturally, prices have been continually rising under these influences, so that in many cases peace time figures have exceeded those during the war.

An ever increasing demand for spot stock from the home trade due, perhaps, as much to the failure of manufacturers to make timely deliveries on contract as to the extension of the consumption of finished products, has created a marked force which will continue to be of material assistance to manufacturers in maintaining present price levels. Every indication and tendency are toward a maintenance of present levels in labor costs and since it is the belief of foremost minds that railroad conditions cannot improve in from three to five years, no great relief can be expected from that source.

The Bureau of Mines will establish an experimental station at Rolla, Mo., to conduct research work in connection with the lead and zinc mining industries of the Mississippi Valley. The station will give particular attention to the problem of treating the large deposits of oxidized lead ores found in certain districts in Missouri.

A Practical Study of Corn Cob Utilization

By Dr. Frederick B. La Forge

Organic Chemist, Bureau of Chemistry, U. S. Department of Agriculture

Use of Products as Paper Stock, Adhesives, Organic Solvents, Wood Flour, Artificial Silk, etc.,
With Cost and Profits of a Manufacturing Plant



Dr. Frederick B. La Forge.

IN the past the natural stores of wealth in our forests have been handled as if they were inexhaustible, with the result that we now are compelled to adopt measures of conservation which should have been put into effect years ago. The Forest Service recently has pointed out that the alarming condition of our lumber and paper industries today is the inevitable result of our previous lack of foresight. Even now the industries which depend on wood products seem very reluctant to turn their attention to more complete and efficient methods of utilization and still more reluctant to consider the possibility of substituting other material for wood.*

The situation of the paper industry is somewhat better than that of the lumber industry, inasmuch as many materials which are suitable for paper-making are available. Of these straw has been very widely used for many years, especially in making certain of the lower grades of paper. With proper refining, it can be used for the finer grades as well. It has also been demonstrated by the Bureau of Plant Industry that hemp straw and corn stalks can be used for the coarser, as well as for the better grades of paper.

The chief obstacles hitherto raised in the way of the large scale employment of these and other crop wastes in paper-making have been the cost of their collection, large quantities of chemicals necessary for treatment, and the comparatively low yields of pulp. Modern economic conditions, however, tend to strengthen the case for such utilization of crop waste.

While it is not to be assumed that wood pulp ever will be completely replaced by other materials in the manufacture of paper, nor even that any other raw material will prove more important, its ever mounting price probably would soon force the use of substitutes, even if there were no other influencing conditions.

Corn Stalks

Insofar as corn stalks are concerned, a more thorough study of the cost of assembling them than those heretofore made is desirable. We have been inclined to accept without question the statement that it could not be done economically. It also has been erroneously assumed that they must be harvested within a few weeks, whereas they are generally in good condition as late as the next planting.

The possibility of economically collecting at least an appreciable percentage of the 100,000,000 tons of corn stalks produced annually if proper methods were applied in the favorable sections of the country does not seem unreasonable.

Under average conditions the yield of dry corn husks, blades, and stalks is about one ton per acre. This means that in many sections of our Middle West, where half of the acreage is in corn, sufficient material would be produced within a radius of six miles to supply a plant with one hundred tons a day for three hundred days in the year and producing about 35 tons of pulp daily. Many such locations are on the large rivers and near coal fields where cheap fuel may be obtained. In some sections of the bottom lands of the Ohio River where solid blocks of corn of many square miles in extent occur, the yields are much above the average.

Only a very small percentage of the corn waste of our Middle West is used for fodder.

The fire risk incidental to the storage of large amounts of corn stalks has been mentioned as an objection to their use. It is obvious, however, that it is not necessary, nor even desirable, to store large stocks near the mill or even in any one place.

We have shown that by digestion with water under pressure a large amount (30%) of soluble gums and other carbohydrates can be removed from dried corn stalks. If the treatment is carried out under proper conditions, this material may have great value as an adhesive and as a source of furfural. The removal of as large an amount as possible of these carbohydrates reduces the amount of chemicals necessary for further treatment of the stalks. This is true also in the case of straw and probably in the case of almost all the other plant materials under consideration.

Corn Cobs

About 20,000,000 tons of corn cobs, which never have been considered as possessing any value as a paper-making material, are produced annually in the United States. Of this enormous quantity of material a large amount is available at the present time in certain localities, although most of it is scattered over too wide an area to be recovered economically. The creation of a market, however, would bring about a change in the methods of handling, and the cobs would be expected to become available in ever-increasing amounts.

A survey of the Corn Belt made with the co-operation of the Bureau of Plant Industry has shown that certain sections, especially on the Ohio River, in Kentucky and Indiana, and on the Mississippi River, in Iowa and Illinois, are capable of providing several mills the year round with 100 tons per day of cobs assembled within a radius of 30 miles at a cost of four dollars a ton or less.

Although shelling is done between November 1 and May 1, the cobs may be stored safely six months or more without any protection whatever.

At present some cobs are used for industrial and household fuel for which purpose they have about one-third of the value of coal. More often they are burned to get rid of them, or they are dumped into rivers or swamps. Since in most cases they have no market

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value, very little information as to the methods of handling and disposing of them was available until the investigation of the Bureau of Chemistry was begun.

Corn Cob Products

One hundred tons of cobs can be made to yield about 45 tons of adhesive "A," 30 tons of adhesive "B," 35 tons of cellulose, 3 tons of acetate of lime, and $1\frac{1}{2}$ tons of furfural. Adhesive "A" may, if desired, be converted into furfural by heating it with dilute mineral acids, the 45 tons obtainable from 100 tons of cobs yielding about 8 tons.

Adhesive "A"

Adhesive "A" is a thick, brown solution (about 32° Bé.) of gums which is obtained by heating dry, field corn cobs with water under pressure and concentrating the resulting extract. About three parts of water are employed to treat one part of cobs and about one-third of their dry weight passes into solution. At the end of the heating operation, a large part of the liquid has been absorbed by the undissolved residue, which must be subjected to pressure to obtain the absorbed portion.

In large-scale practice, the Kutztown system of digestors and rotary press has been found best adapted to the handling of this material. This outfit is used for the reduction of garbage which presents a more difficult problem than the treatment of corn cobs. The total amount of solution to be evaporated finally to the consistency of the adhesive is about four and one-half times the weight of the cobs. The distillates contain acetic acid which could be recovered at a profit. The cellulosic residue in the form of press-cake is the source of pulp, cellulose flour and adhesive "B."

Uses of Adhesive "A"

The principal use of adhesive "A" contemplated is as a substitute for the silicate of soda now used in fibre-container and wall-board manufacture.

Over one hundred and fifty concerns in the United States are engaged in the manufacture of fibre-container, board and allied paper products. This industry depends almost entirely on waste products, mostly used paper, for its raw material. Old newspapers, paper boxes, clippings and discarded containers are pulped to appear as new containers, etc.

Everyone is familiar with two types of fibre board, viz., the corrugated made by pasting a fluted inner sheet of strawboard on to a flat sheet of pasteboard, and the solid or laminated type, made by pasting two or more flat files together. The corrugated type is the older, but the solid type strongly predominates in the trade.

All these products are made by machine operations and large amounts of cheap adhesives are required.

At the present time silicate of soda is used practically to the exclusion of all other materials in this line of work. It is estimated that the consumption of silicate by this industry is between 300,000 and 500,000 tons annually.

Three machine runs have been made at the plants of container-board manufacturers to test corn-cob adhesive under practical mill conditions as a substitute for silicate. The information obtained from these runs has proved that with slight change in the method of application cob adhesive is suitable for this line of work.

Single-faced corrugated board may be pasted with no change in the present working conditions whatsoever. Observations for over a year on the condition of board so pasted and submitted to all common tests have failed to show any unfavorable changes. On the other hand,

samples made up with the use of silicate were often discolored along the lines of contact and had lost much of their water-resistance.

Pasting double-faced corrugated board on the machine in common use proved rather difficult. The application of heat as in common practice tends to soften the adhesive rather than to set it. Its use in this case seems doubtful without considerable change in equipment.

The one run made to test cob adhesive for pasting four-ply solid fibre board was partly successful, the principal difficulty being that the time required for setting seemed too great under the working conditions. The adhesion was satisfactory where only one face of the board received a coating, as was the case between the upper and lower plies. In the middle of the board, however, where two coated faces came in contact, the layer was too thick to permit of quick setting. This could be remedied by the use of a "shower" attachment with which many machines are equipped and which applies adhesive to only three faces in pasting four-ply board. By reducing the viscosity of the cob adhesive to that of the silicate by the application of heat, it is quite probable that satisfactory results would be obtained without the shower attachment. We have been unable to arrange for a second run in which we could profit by the experience already gained.

As far as the finished board is concerned, very little difference in strength or water-resistance was observed when it was compared with the stock pasted with silicate. The board has been under observation for nearly a year.

Adhesive "A" as a Substitute for Dextrine and Organic Gums

Another promising field of usefulness for adhesive "A" is as a substitute for dextrine and other organic gums and glues in the labeling of containers and in the manufacture of coarse envelopes and paper bags. Experiments have been made by an important concern to test cob adhesive in the manufacture of various kinds of envelopes and the results so obtained show that it has a large field of usefulness in this line of work. It cannot be used for pasting the finer grades of white stock. For the sizing of walls previous to the application of paper, cob adhesive proved very satisfactory. Corn-cob adhesive has no food value and therefore has the advantage over dextrines and gums in not attracting insects. At least samples of paper pasted with it have not been attacked under conditions where those pasted with other adhesive have been seriously affected.

It is safe to say that mixtures of dextrine or animal glues with cob adhesive will result in products which may find a still wider range of application.

At present there are on the market two well-known adhesives which are supposed to be manufactured from sulfite waste liquors. These products are so similar to the material from corn cobs as to be distinguishable from it only by chemical tests. Their physical properties, such as viscosity, time required for setting, strength, color, etc., are practically identical. Both of the sulfite-waste adhesives are widely used in paper-box manufacture and as core-binders in foundry work. Neither is used in competition with silicate for the reason that both command a much higher price in the present market.

Corn-cob adhesive differs chemically from the sulfite-waste adhesive, and, on account of its high pentose content, may be converted to a large extent into furfural.

Adhesive "A" as a Source of Furfural

By treating adhesive "A" with dilute mineral acids, about 25% of furfural based on the total solids present may be obtained. Furfural never has been a commodity on the American market and has but recently appeared in trade in Europe where it is now prepared in commercial quantities from another source than corn cobs. This material has some very interesting possibilities as a substitute for formaldehyde in the manufacture of plastics such as bakelite and as a solvent for certain gums and resins, and for cellulose acetate. It also finds application in dyestuffs manufacture. It is a colorless liquid of pleasant odor, boiling at 160° C., and is completely miscible with organic solvents. In water it is soluble to the extent of 10% and distills over with water vapor below 100°. This property renders its recovery even from dilute solutions a very simple matter. It could probably be obtained in large-scale operations for less than four cents a pound, although no accurate calculations have been made. Should it develop that furfural would find a large enough market, it might pay to convert all or a large part of the adhesives into this product.

Adhesive "B"

The cellulosic press-cake referred to is ground and subjected to a short treatment at atmospheric pressure with ten parts of boiling, one per cent. caustic soda solution to separate the alkali-soluble material from the true cellulose. The nature of the dissolved material is little understood except that it has weak acid properties and probably is related to cellulose. By the caustic treatment, about 40% of the dry weight of the residue is dissolved to a black liquid, which, after evaporation to the proper consistency, has fairly good adhesive properties. A slight excess of alkali must be present to permit its concentration without the formation of deposits of solid material. The very deep color of this material would make its use objectionable for most purposes. Its proper field seems to be in the manufacture of briquets and as a core-binder for which purposes it is being tried out. In case no market should develop, the solution could be run off without risk of damage, as it is perfectly neutral and odorless, or used for the recovery of soda ash.

Cellulose

The washing of the black liquor from the cellulose is accomplished best by a series of three continuous filters. After washing the pulp is handled in the same manner as is wood pulp. It is screened, concentrated and bleached in the usual manner and most of the water removed by another continuous filter. If the pulp is intended for use in paper manufacture no operations other than baling for shipment are necessary.

Possibilities of Corn Cob Pulp for Paper Manufacture

The fibre of corn-cob cellulose is so short that in the early stages of our investigations it was not considered as possessing any value in paper manufacture except possibly as a filler in the place of clay, in book papers. Its high power of absorption indicated that it might serve also as an ingredient in the furnish of blotting papers where strength was not an important consideration. Our first small scale experiments were made to test its usefulness in these fields, and our results were sufficiently successful to justify going into the matter more thoroughly. Consequently, we requested the Forest Products Laboratory to make some further tests.

Hand-dipped sheets of blotting paper containing varying proportions of corn-cob and aspen soda-pulp

were made and compared with respect to their rate of ink-absorption according to the method devised in the Leather and Paper Laboratory of the Bureau of Chemistry. The results of these tests indicated that the addition of cob pulps very greatly increases the absorptiveness of the samples. The results of our tests are indicated in the following table:

Furnish		Rate of absorption 228 seconds
Aspen soda-pulp	Cob pulp (none)	
100%	(none)	103
75%	25%	50
50%	50%	"

In the case where 50% cob pulp was used, there was some tendency for the surface of the sheet to rub off, which was not noticeable in samples containing less. Probably not more than 25-30% should be recommended for this type of paper.

In order to test cob pulp for book paper, hand tests were made, with results which indicated that as much as 12½% may be used without cost of strength and only a slight weakening was observed as compared with control papers containing up to 25%. A higher percentage caused a marked falling off in strength.

A Fourdrinier machine run with a furnish made up of 60% bleached sulfite, 40% cob pulp and 3% size was carried out. The resulting sheet was of very fair general appearance and proved to be superior in strength, as indicated by the Mullen and folding tests, to the control sheet where soda pulp had been substituted for cob pulp. There were some dark specks noticeable in the sheet containing cob pulp which are in all probability due to our manner of carrying out the first digestion of the cob. It appears that when a gas-heated copper autoclave is used for this operation, the cobs in contact with the metal over the flame become overheated and it is to the small amount of charred material that the specks are due. However, these specks were only few in number, and should not appear in pulp made in large-scale operation in steam-heated digestors. In general, we believe that 40% cob pulp is too high for the best results and that 30% or less would have given a more satisfactory sheet. No difficulties were reported in handling the stock on the machine.

In order to test cob pulp for news print paper, two machine runs were made using unbleached sulfite pulp and unbleached cob pulp. The first run was with equal parts of each with 1½% of size and a slight amount of red and blue dye. The resulting sheet was of better general appearance as regards color and freedom from specks than ordinary news print paper.

There was some difficulty experienced in handling the stock on the machine owing to the tenderness of the wet sheet. It would doubtless have been better in this case also to limit the amount of cob pulp to about 30%, and to employ a mixture of ground wood and sulfite for the rest of the furnish.

A second run was made in which 70% cob and 30% sulfite was used but the sheet was too soft and weak to be considered for news print. In this case also considerable difficulty was experienced on the machine due to the tenderness of the wet sheet.

There can be no doubt from the results of these experiments that cob pulp may be employed to a limited extent in several grades of paper, including news print. We believe, however, that it should not be attempted to employ it in amounts greater than about 30% in any case.

Corn Cob Cellulose as a Substitute for Wood Flour

Wood flour is generally made from spruce, pine or poplar by grinding very finely between stones or some-

times steel rollers. As a large amount of mechanical energy is necessary for its manufacture, it is generally produced where water power is available and where there is a good supply of raw material.

Before the war, much of the wood flour of commerce was imported from Norway and some is obtained still from that country. Its principal use is as a filler for dynamite for which purpose about 20,000 tons are used annually. About the same amount is used in linoleum manufacture and about half as much for plastics, such as bakelite, etc. Some is used in the preparation of bates for tanning.

If corn-cob cellulose is to be used as a wood-flour substitute, the pulp must be dried and ground. After this treatment it is very similar to wood flour but possesses a higher absorptive value.

Result of experiments indicate that cob-cellulose flour is suitable for dynamite manufacture, and further tests are now being made to determine its value in this field. Tests of its usefulness in plastics gave very encouraging results. At the present time experiments are being carried out with a view of substituting cob cellulose for wood pulp for artificial silk manufacture. It has been suggested that cob cellulose could be used for polishing tin plate and for other purposes where as yet no tests have been made.

As indicated by a single test in connection with linoleum, the material is not suitable in this line of work, although a more thorough investigation would have to be made to settle this point satisfactorily.

A Brief Description of the Proposed Process and Manufacturing Plant

In order to handle cobs in the most economical manner possible, about 100 tons a day should be treated. Various engineers familiar with the operations as they are employed in other industries not connected with the Government service have planned such a plant and estimated its cost in co-operation with the author. There is no specially built equipment in the proposed plant but only stock apparatus and machinery which can be obtained without special construction.

Cobs are to be delivered in cars or barges and piled by means of conveyors until used. For their digestion with water, a battery of four digestors supported over a suitable hopper is to be used. Under the hopper is a rotary press which discharges the pressed material about 40% dry while the liquor drains into a pit where it is allowed to settle before evaporation.

The evaporation is accomplished by means of a triple-effect tile-lined evaporator with bronze connections and heating surfaces. The press cake is broken up and mixed with water by means of a bladed screw conveyor, which delivers the material to a second rotary press. The final press cake is ground and the material delivered to a continuous cooker with the proper amount

of 1% caustic solution and from which the cooked material is delivered in the form of a mush. This mush is filtered to a continuous filter, the liquid going to a second triple-effect evaporator if it is desired to save adhesive "B." The cellulose goes to a series of two other filters where complete washing is accomplished.

From the wash filters the pulp passes to a repulper where it is highly diluted before screening by means of a rotary screen. It must then be concentrated by means of a filter after which it is bleached in the usual manner by means of chlorine. The bleached pulp is filtered and washed and as much as possible of the water removed by a fourth filter which delivers it about 40% dry.

For paper stock the material is baled for shipment at this stage. For conversion into wood-flour substitute, the moist pulp

must be passed through two rotary drum dryers from which it emerges about 85% dry. It is finally ground and screened in one operation and conveyed by an air current to the storage or packing room.

Such a train of apparatus would handle 80 tons of cobs per 24 hours.

In order to insure against shut-downs and to allow some elasticity in the manner of operating, it is proposed to install a second train parallel to the first up to the stage where the cellulose is converted into flour. It is to be assumed that at least half of the output of cellulose would be for paper stock for which purpose it would not have to be dried.

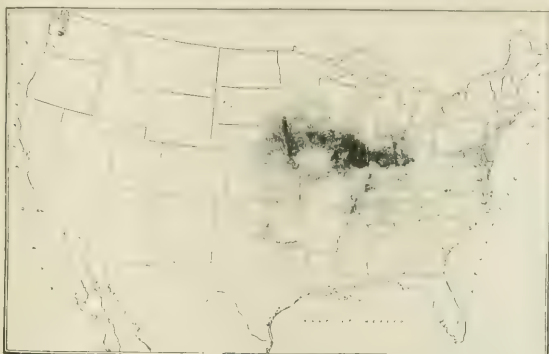
While running at full capacity, both trains together would handle 160 tons per day, although all calculations of costs and profit are based on an average run of 100 tons. The evaporators could handle the liquid resulting from the treatment of about 125 tons.

Mechanical and electrical energy would be produced incidentally in reducing the pressure of the steam to be used in the evaporators. Sufficient excess electrical power would be available to produce caustic and chlorine for the process, for which a suitable plant is included in the plans and estimates. All construction, piping, sewage system tanks, office building and property also are provided for.

Such a factory would cost in the neighborhood of \$800,000. The initial outlay would probably be about half of this amount as, at first, adhesive "B" and acetic acid would not be recovered. Only one train would be installed and no caustic and bleach would be made until the process was a demonstrated success.

Cost of Operating and Value of Products

Most of the operations to be used in the proposed plant are continuous and automatic and hence require few operatives. Cheap coal, a good supply of cobs, abundant water supply as well as adequate transportation facilities are the necessary requirements of a suitable location.



Distribution and Density of Corn Production in the United States.

Plant No. 1

The approximate daily balance sheet of a full sized plant making all possible products with respect to conditions in a certain town in the Ohio Valley is here presented:

DAILY BALANCE SHEET OF CORN COB UTILIZATION PLANT NO. 1.			
Expenses		Products and value	
100 tons of cobs at \$2.50.....	\$250	45 tons adhesive "A" at \$24.....	\$1,080
60 tons of coal at 2.00.....	120	30 tons adhesive "B" at \$20.....	600
3 tons of lime at 10.00.....	30	30 tons cellulose at \$40.....	1,400
5 tons of salt at 4.00.....	20	3 tons acetate of lime at \$70.....	210
Personnel	200	1.5 tons by-product furfural at \$200	300
Interest and depreciation on \$800,000 plant.....	400		
Total	\$1,020	Total	\$3,290

The value of adhesive "B" is problematical and that of furfural is still quite uncertain; the estimated value of \$200 per ton in the case of the latter is, however, probably too low.

In case it were decided not to attempt to market it, adhesive "B" would be burned and otherwise treated to recover soda ash, which would be returned to the process as caustic according to common practice in the manufacture of soda pulp from wood.

In this case the cost of the receiving equipment would have to be added to the cost of the plant but there could be the choice of marketing caustic and chlorine or of disposing of the surplus electrical energy in some other manner than indicated in our plan.

Plant No. 2

Under less favorable conditions, such as may be regarded as average in localities under consideration, the balance sheet of an abbreviated plant planned on the same lines as the full sized factory, but equipped with one train and without equipment for producing adhesive "B," acetic acid, caustic and bleach, and handling 50 tons of cobs per day, would run about as follows:

DAILY BALANCE SHEET OF CORN COB UTILIZATION PLANT NO. 2			
Expenses		Products and value	
50 tons cobs at \$4.00.....	\$200	22 tons adhesive "A" at \$24.....	\$528
30 tons coal at \$4.00.....	120	17 tons cellulose at \$40.....	680
1½ tons caustic at \$100.00.....	150	¾ ton by-product furfural at \$200.....	150
1½ tons bleaching powder at \$60.00.....	90		
Personnel	100		
Interest and depreciation on \$400,000 plant.....	200		
Total	\$860	Total	\$1,358

Such a plant would show a net profit of about \$500. The value of the various products are estimated very conservatively and it is not improbable that the cellulose especially would sell for a much higher price than that indicated, as it would compete with products now selling for from \$60 to \$200 per ton. The recovery of soda ash would result in an additional profit of about \$100 per day.

Furfural has very interesting possibilities, but for the present it would not be well to depend on it to the extent of counting it as a certain source of profit.

The principal obstacle in the way of placing this project on a commercial basis is the excessive amount of capital required to start it, together with the difficulty of bringing together the parties who have the cobs and those interested in adhesive and paper manufacture.

The economic situation has been well covered and the various phases of the process have been tested on a semi-works scale where several hundred pounds of material were handled. It remains now for some one to undertake the financing and promoting.

About 1½% of furfural is formed during the digestion of cob with water for the production of adhesive "A." It passes off with the steam while the pressure is being relieved before discharging the digestors and may be collected by means of a surface condenser. The condensate yields upon fractionation that portion of the furfural which is designated as by-product furfural.

These figures are conservative with respect to present conditions but can be modified to obtain any idea of the expected profits under other market conditions. The pre-war price (1915) of silicate of soda was about \$10, wood flour \$18 and soda pulp \$30.

The Brunner Mond Co., alkali manufacturers, Amherstburg, Ont., is building an addition to its plant and will install equipment to increase its capacity 50 per cent.

* * *

The Tubize Artificial Silk Co., 487 Broadway, New York, are sending a selected party of young women to the home plant of the company at Tubize, Belgium, to qualify as instructors of female help for its new plant at Hopewell, Va.

Current Comment in the Dyestuffs Trade

THE Sixth National Exposition of the Chemical Industries presents the opportunity to the American dyestuff manufacturers to show the technical and lay public what has been accomplished since the Fifth Exhibition held in Chicago one year ago.

Doubtless some dyestuff manufacturers can avail themselves of the opportunities and will show something new developed in the past year, but the cold facts that cannot be hidden, reveal that there have been mighty few additions to the list of American-made dyestuffs in the past twelve months. We do not believe anyone will dispute this statement, but there are just as certainly a good many different opinions as to the reasons for the slow development. Some will say that the hesitancy and deliberate procrastination regarding adequate protective legislation at Washington has put the brakes upon development work. Others will say that the uncertainty regarding necessary raw material, anthracene for example, has retarded the appearance of anthraquinone derivatives. Still others

will explain the slow progress of the past year by the general scarcity of crudes and incidental necessary chemicals, like methyl alcohol, consequent upon the upset labor and transportation conditions.

Now all these things are factors, but only a minor degree to our mind. As we have mentioned before, all the comparatively simple anilines have been produced successfully and in most cases they are equal or superior to the former German prototypes.

The real reason for the slow progress, as we see it, is our lack of trained technical workers. We are minus the research and operating staffs necessary for the production of the lacking colors in an economical manner. One large manufacturer produced certain very high-grade vat colors and anthraquinone derivatives in a fairly satisfactory quality, but at such a cost as evidently to preclude commercial success, for it is generally understood their vat color programme has been curtailed to two or three products and these latter must be marked up approximately 100 per cent. over the originally quoted prices.

The successful utilization of by-products is undoubtedly a very important factor in the cost of the more complicated colors. This is a subject that barely has been scratched in our aniline color plants. There are two ways of acquiring the technical equipment necessary for further color development. One, the slow way that may take years, develop it ourselves; and the other, the quick way, go to the source, Germany, and hire or buy it. It is rumored that one of our large producers already has adopted the latter method.

It seems fairly well established that English manufacturers have been operating on a small scale in the field of anthraquinone colors and although they probably have exceeded our limits both as regards variety and quality, still their advance has not been sufficiently marked to place them very far ahead of us, nor to enable them to teach us much were they willing to do so.

For quick action in further development it seems we must fall back on Germany, distasteful as this must seem to all.

Most of the writers on the subject of American dyestuff manufacture overlook a very important angle. No dyestuff industry confined to a domestic market can be really commercially successful. The dyestuff industry requires a world market in order to keep up the economical production necessary to highest efficiency. Therefore, let them quit thinking in terms of "An American Dyestuff Industry for America" and begin to think of an American Dyestuff Industry succeeding the German as the dominator of the world's markets.

Let us be honest and admit that on that road only lies commercial dyestuff success.

Either the Germans are eventually to resume the dominating place in the world's dyestuff market, or they are going to be replaced by some other nation. There are only two real competitors for the place, England and the United States; and we have many advantages over England now. Let us conserve what we have and add all we can against the day when it shall be decided who shall occupy the dominant position. Other than her trained workers Germany has no advantage over us in the new race for the world market. In fact she has so many disadvantages in the way of fuel and raw materials that she may be regarded already as heavily handicapped against resumption of her old place.

Very few American dyestuff makers have given a thought to the big market, but they must realize that the present condition of this industry throughout the world is a transitional one purely. The man who acts wholly as an opportunist will probably have no place in the real industry when it finally shapes itself. Too many are wholly satisfied to exist now and go on hoping that conditions will so shape themselves as to permit their future existence and profits instead of planning and striving to bring about the conditions that will insure their continued success. If they cannot go ahead within a reasonable time let them import brains—better these than German dyestuffs. Now is the time to decide whether we shall drift along as we are, controlled by conditions, or get out and bring about the conditions necessary to a permanent successful American Dyestuff Industry.

In regard to the Exposition itself and all future ones, as this is written in advance of the opening and before we have any idea of the nature of the exhibits in detail, it is not amiss to link up the exhibits with what we have said herein regarding new developments.

An exhibit to be valuable must be practical without being too general. It is better to lay particular stress upon one product or one class of products with merely a "word in passing" on the rest of the line. To try to give all equal prominence means in most cases a general lack of power to arouse interest in any. We know of a few firms that are going to limit their exhibits to the most recent development, and we hope the tone of the above exposition will be along similar lines. Unless this idea will prevail there will be no excuse for future Chemical Expositions so far as the dyestuff industry is concerned.

Quality of American Dyestuffs

There has been such a misapprehension of the quality of our own dyestuffs that the Dyes Institute decided to make a special educational campaign to present the facts to the consuming public at this exposition. Their published matter for distribution will have been gleaned from contributions from all who were qualified to voice opinions on the subject and who availed themselves of the Institute's invitation to contribute ideas for subsequent editing by their committee. We have seen so many sales tags attached to all sorts of goods in the department and other stores bearing the legend "American Colors—Not Guaranteed" that the general subject of color fastness requires elucidation.

The general misunderstanding of the fastness of American colors as compared to foreign ones really is caused by the loose way in which the term fastness has been used and understood. This loose and general use of such expressions as "Fast Color" has given rise to implied meanings differing from each other as this phrase has been applied to different materials.

First of all there must be a general understanding that fastness as applied to any colored material is only a very broad, general term meaning the property of resistance to some action, and that although we may imply or infer anything resisted, we must specify it at least in our minds. Therefore, the public must begin to think specifically and, forgetting the old "Fast Color" label, think of definite actions resisted, such as "good resistance to sunlight," i. e., fast to light, or "good resistance to severe washing and chlorine," i. e., fast to laundry action.

It is further to be understood that even when used specifically in connection with a definite action such a phrase as "fast to light" is only relative. There is no such thing as absolute fastness, and any color can be compared only with others in noting its resistant properties.

It is obvious that different colored materials require different resistant properties. A fast-color gingham should be fast to light and washing; while a fast-color upholstery fabric need only be fast to light and rubbing. It would never be washed in all probability. On the other hand silk stockings need be fast only to washing. They would hardly be exposed to strong sunlight for long periods.

Practically all the aniline colors are definite chemical compounds. Although the dyestuffs are very complex bodies, each one has just as definite chemical properties as any of the simpler chemical compounds such as common salt or sugar. The dyeing properties vary on different fibres; but in a general way we may say that the fastness, or resistance if you like, of any color is a property of the color itself and is affected only in a minor degree by its application. Being definite chemical bodies with definite properties, the lot that Jones makes in San Francisco is going to be chemically iden-

tical with the one Hans Feldwebel made in Frankfurt a/Main and have the same fastness properties.

Every American product is chemically identical with the same product produced anywhere else, has exactly the same properties, and there is no question of inferiority.

A large proportion of the statements that our colors are not as fast as others arises out of ignorance of the above facts or a deliberate comparison of two dissimilar products, in which an American color of indifferent resistance is compared to a totally different chemical compound of good resistance.

We are probably making not over 250 colors in this country now and we formerly imported about a thousand. Now among these, roughly seven hundred colors not yet produced here, were a good many whose resistance to light, to single out a specific fastness property, was as good as many included in the 250 we now make here. On the other hand, we have in a small way even now equalled the best that was ever imported and there is every prospect of a regularly increasing production. No pessimism regarding the quality of American dyestuffs is justified.

To everyone it must be plain that it was impossible for a complete American Dyestuff Industry to spring into being just as soon as our foreign source was blocked.

Naturally the colors that were the simplest to manufacture appeared first in the market and just as naturally these colors were used by various mills for many purposes for which they were unsuitable because the suitable products were not available. This make-shift period has passed in a great degree. We stand today in the position of lacking very few of the products required for complete lines of "fast color" materials, and these few will be available from American plants very shortly.

A large proportion of the fugitive colored materials, that is those materials whose colors show poor resistance to various actions, is undoubtedly due directly to the selection and use of the wrong color by the manufacturer of the colored material in question. That this proportion is any greater now than before the war is extremely doubtful. We heard just as many complaints of materials whose colors were fugitive to light, to washing, to perspiration, etc., in the pre-war days as we do now, but at that time the blame was not placed on the American colors as there were none. However, many unscrupulous or ignorant manufacturers used fugitive colors, where they should have used fast colors, from choice instead of necessity as was the case during the earliest development of the American Dyestuff Industry.

The jobbers and retailers can secure a much greater quantity of cotton and woolen goods, in particular, that are of good fastness to light than they get at present by merely specifying and insisting that the fastest colors available be used. We realize that during a general shortage of all sorts of materials is a bad time to attempt to force an improvement in the quality upon the retailer, jobber and manufacturer; but at the same time the public must face squarely the blame for a lot of the fugitive color work on the market because it is in too many cases willing to accept any sort of coloring in order to secure the fabrics.

The consuming public can best aid themselves by insisting that the retailer furnish materials that are reasonably fast to all the actions that the material in question must withstand, refusing absolutely to accept the statement so often heard and seen "American Colors—Not Guaranteed." If it is emphasized sufficiently and repeated often enough to the retailer that the manufacturer can secure American colors of satisfactory resist-

ance, the American manufacturers themselves very shortly will receive the message by way of insistence from their jobbers, that the fastest colors available be used.

General Condition of the Industry

The curtailment of both the silk and woolen industries to such an insignificant production as at present, has of course cut into the dyestuff sales tremendously. The cotton industries are all affected to a less degree but still the mills are busy mainly on old orders for which the dyestuffs were purchased mostly thirty to sixty days ago, and new orders are few and small. We can look for no marked improvement in the textile industries before early 1921 according to a fairly well expressed agreement of opinion among its members.

The leather industries are extremely dull, but the paint industry holds up in fairly good volume. The paper mills are busy and are catching up in certain lines.

On the whole the dyestuff market will be no better and possibly somewhat duller before January, 1921, in volume of sales. The slump was noticeable in July and very marked in August. September shows no signs of being an improvement over August, which was about 50 per cent. of normal volume of sales. Prices hold up, however, due to the same conditions that maintain prices at high levels in many other lines. Raw materials are not cheap or plentiful yet, and until there is a marked drop in these the dyestuff prices must remain high in spite of the small volume of business.

There have been several absorptions of small manufacturers by larger ones during the past year and this undoubtedly will continue. The day of the one or two-color plant is over. Every manufacturer has to have a fairly well-balanced production programme with a latitude for variety as well as quantity in order to stabilize conditions as far as may be.

Imported Dyestuffs

There still exists considerable grumbling about the conditions and regulations still in force which govern importations. Swiss production is severely hampered by lack of raw materials and some of the products for which we have depended upon this source for the past four years are very scarce. Rhodamines and auramine in particular are rare and high priced at present. The German Reparation dyestuffs are all distributed and it is too early to predict how much or when any additional colors will be distributed from the Cartel portion.

The Swiss Invasion

The purchase of the Ault & Wiborg aniline color plant by the Swiss combined manufacturers eventually must mean that a lot of the products formerly imported from Switzerland will be made in Cincinnati. The reorganization, however, will proceed deliberately, no doubt, in view of the large number of direct and acid colors being made at the plant now. We can look for nothing new or startling in the way of immediate results from this important move. It was no surprise when the Swiss came over. The surprise consisted in the long delay. It would seem to have been more logical to do it two years ago. That this Swiss combination of Society of Chemical Industry, Sandoz Chemical Works and the Geigy Company will play an important part in the dyestuff developments here seems assured. Taken collectively they have a large list of permanent achievements all accomplished in the past in the face of German competition.

It goes without saying they know the game from all angles and are going to make things interesting for competitors.



New Laboratory of The Newport Company

By George E. Bird General Superintendent, the Newport Co.

THE growth of the laboratory of the Carrollville, Wis., plant of the New York Chemical Works, Inc., in three years from seven wooden desks, a balance room and a store room, which accommodated the research and analytical work of the organization at the time, to the present imposing structure recently completed and shown in the accompanying illustration, reflects the progress of the company in dyestuffs and heavy chemical manufacture during this period.

The laboratory building is in a centrally located rectangular plot embellished with a velvety lawn and flower beds that thrive in spite of the atmosphere of a busy chemical plant. The building is of structural steel and vitrified brick construction, one story in height, 220 feet long and 61 feet wide. The main entrance opens into a wide corridor which runs practically the entire length of the south side of the building, connecting the four sections into which the working space is divided.

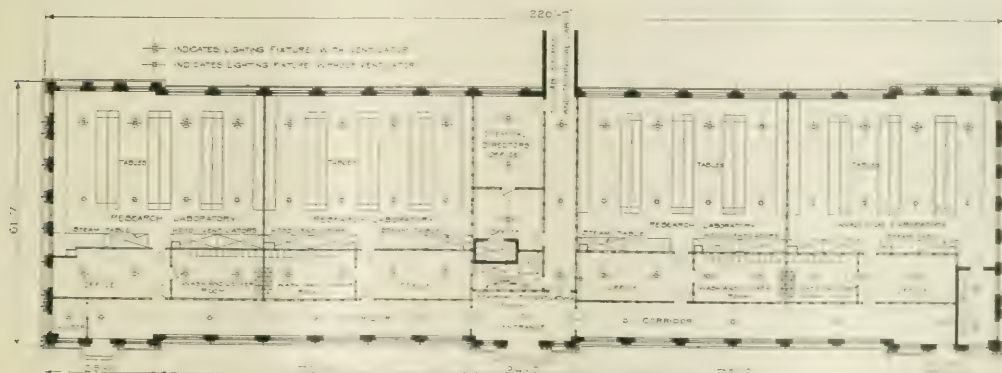
Near the center of the building is the office of the chemical director, with fire-proof vault for the permanent chemical records. The working space is divided into four sections with ample accommodations for the eight groups concerned with their respective part of the analytical control and research work of manufacture, each group being headed by a chief chemist.

The building is provided with a modern forced draft ventilating system. A large fan in the basement draws air through a water spray scrubber and sends it to all parts of the building by means of ducts in the ceiling. The openings into the various rooms are directly above the electric lighting fixtures. Another system of ducts with openings at various points along the floors, leads to a second fan in the basement, for removing the vitiated air. The system is so arranged that in winter the fresh air is passed over steam coils both before and after the spray scrubber, allowing perfect control of

the humidity and temperature. This arrangement is designed to insure comfortable working conditions at all seasons.

The interior walls are finished with white octagon tile to a height of seven feet, while the upper portion as well as the ceilings are of white plaster. The floors are laid with red tile which is rounded at the base of the walls and extends six inches up the walls, a feature which prevents the possibility of any dirt accumulating in the corners. The inner side of the corridor and the partitions between the divisional laboratories are made up of a white tile base surmounted by panels of Florentine glass set in oak, the whole being about seven feet high.

Among the special conveniences of the laboratory are a plentiful supply of distilled water from a continuous still, and large ventilating hoods. The work rooms in each of the four sections are identical in size and general equipment, which consists of three double laboratory tables, twenty-four feet long, two single wall tables, thirty feet long; a steam table, and a ventilated hood. The tables are oak with alberene stone tops, and are plentifully supplied with cupboards and drawers. Reagent shelves extend along the center of the double tables and along the back of the wall tables. A stone gutter runs along the center of the double tables, discharging into the porcelain sink at either end. All tables are piped along the entire length for steam, compressed air, vacuum, hot and cold water and gas. A motor-driven line shaft extends along the top of the reagent shelf for operating stirring devices used in experiments. The hoods are equipped with vertical sliding windows which may be raised singly or all together, leaving the entire opening clear. Electric drying ovens and steam baths complete the mechanical equipment. In the line of chemical glassware, every known device necessary for the successful carrying out of chemical research has been provided.



Floor Plan of New Laboratory of the Newport Company.

CHEMICAL AGE

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A Consolidation of
The Chemical Engineer
and Chemical Age



THE amalgamation of five great chemical corporations into a colossus that will occupy in chemical manufacture the position held by the United States Steel Corporation in the metallurgy of iron, is the offspring of the conflict of interests that in the controversies of a year ago around the Longworth Bill, sought to make capital in the chemical industry safe from German aggression and the nation independent in the key essentials of war and peace.

Preponderance of influence of consuming and importing interests subverted the national interest and denied to an industry that the blockade of Germany brought into being, the opportunity of balanced growth.

The advantages of German chemical consolidation are reflected in the new organization which will dominate every avenue of production and supply in its approach to the products of the benzene group.

These efforts duplicate similar enterprise in the chemical industry of each of the advanced manufacturing nations.

Efficiency in production and management is a more certain bulwark to foreign competition than political favor, which in any event should not go beyond that necessary to keep every man upon his mettle.

Somewhere between Abbott Road and Marcus Hook and Calumet and Newtown Creek, a man will come to the top.

Will he have the sagacity and cleverness of Judge Gary?

THE original Nelson Morris is one of the classic figures of Stock Yard history.

While doubtless in his day concerned more with the breed of beves than with that of men, to him is due this belated credit for his tutelage of Tom Wilson.

Salesmanship made Thomas E. Wilson and endowed him with capacity to sell his ability and his vision to a group of bankers who backed him for its realization.

The tribute that the packer pays the chemist shows how times have changed and emphasizes the defi-

ciency in the latter of what is so conspicuous in the former.

LEARN well one thing,—one subject, one process, one department of chemical manufacture, one chemical industry, and capitalize your proficiency to the limit, for of what use is what one knows if he can not sell it and thereby benefit others.

Get out of the exploited class in which we all are more or less active members.

Get thee behind me, Mediocrity, that I may greet Capacity!

Ignorance refuses to learn or can not learn that only individual effort will do this and looks to amalgamated ignorance to do that for which individual ignorance has neither the incentive nor the power.

Intelligence knows that it must pay for its experience and that proficiency has its price.

IF progress alone were the end of life it would doubtless have been provided that each generation should start with the hard-won experience of its predecessor.

It was decreed, however, that each soul must work out his own salvation. The material refinements of life serve only as added stimuli.

Technical men are nourished at the same breast and differ among themselves only in loyalty to their respective *Alma Mater* and in the different professional principles and ideals there instilled.

The over-lapping, practical interests of maturity serve to contribute to their solidarity and should make that community of interest a most beneficent influence.

Senator Warren G. Harding, in this number of *Chemical Age*, emphasizes this fundamental inter-relation of technical professional men and urges them to wield the influence of which they are singularly capable in the broader affairs of national life.

That commercial advertising should be recommended in a movement to secure popular recognition of the value of technical professional men to society, is a commentary on the indifference of the class to the broader interests of society to whose material progress it has contributed so much.

As things go in this world we get the treatment that we deserve.

IF the sincere tribute of a candidate for the presidency of the United States mean anything it indicates the deepening penetration into the public consciousness of the place of the technical man in the material progress of our country.

Senator Harding substantially says that if the technical man wants in governmental affairs the recognition that industry accords him he must work for it and win it, just as he has done in the field of production.

For obvious reasons technical men cannot at once be politicians and produce results in their special fields.

What Senator Harding rightly insists upon is that men trained in the industrial professions shall concern themselves to have government reflect the same efficiency which is their aim in the work of production.

Ours truly is a representative democracy, for the kind of government we get reflects the calibre of the men we select as our representatives.

IN this statement addressed to technical men on the opportune occasion of the Chemical Exposition, one sees assurance that Senator Harding, if success crown his enterprise, will lend the influence of his interest not only to correct promptly the conditions which Dr. Alsberg describes, but to advance those measures with which technical men are professionally concerned, viz., the co-ordination of the various engineering activities of the government in the establishment of a Department of Public Works, and the efficient and more fruitful conduct of governmental scientific activities.

THE inherent soundness of our financial and industrial structure is evidenced by the inconsequential results of the severe break in cotton, wool, silk, leather and sugar prices and curtailment of bank credit, events which ordinarily would have produced an after-math of panic.

How can we expect deflation of prices when the stage is set not only to resist deflation of what constitutes 85 per cent. of the cost of goods, but to secure a greater share, a process which in one direction makes necessary a rise in another?

Prolonged self-denial, public and private, in the whole gamut of human needs, except, however, the profligacy of unaccustomed wealth, makes any lapse in productive activity only temporary and local, and justifies the belief that America has not even entered upon that satisfaction which must be met before general equilibrium of production and consumption can be approximated.

HIGH wages should be the goal of both employer and employe, the latter receiving them by virtue of an output that warrants them and the former paying them as labor's rightful portion.

Subversion of this practical ideal results in economic distress which all suffer.

Inadequacy of labor, whether intentional or the result of demand that grows by what it feeds upon, has been the prolific mother of all the labor-saving devices from which labor has benefited the most.

Notwithstanding the present great use of machinery in the work of production, greater demands must be made upon this instrument, that a progressive standard of living may be maintained, that is, that the higher wages may be paid in the increased production thereby made possible.

Is inventive genius deaf to the cry of necessity, or is its field exhausted?

NEVER was the homely habit of thrift better rewarded than it is today.

With first class industrial securities that can be bought to net 8 per cent., how many technical men are saving money over against the time, when, with flabby chops and growing girth and the press of younger men, the rod and staff of independence may comfort them.

This rate of interest, reflecting the high cost of money which is just as essential to the production of goods as labor, will deflate the cost of credit by the encouragement of saving, whereby numberless small amounts are coagulated and separated for definite use in production.

Profligacy is a violation of trust and, like every breach of economic law, carries its own penalty, borne by all.

JUST as the selling price of a commodity in a competitive market tends to the cost of production of the least efficient producer; so the market price is set by the most needful buyer.

America's place in world commerce is conditioned by the former law.

The latter principle will regulate the price of commodities in the surplus-producing nations.

The domestic consumer should not expect great price recessions in the basic commodities with the present volume of unfilled wants abroad until resumed production approximates its local needs.

Behold the wisdom of a process that frowns upon the cataclysmic and demands the untampered operation of all of Nature's ways!

WITH America the only nation upon a gold basis and the arch-creditor and reservoir of wealth, progress in export trade, to which all look to stabilize domestic production, will be with increasing difficulty.

For these conditions create an exchange situation which makes this country an easy place in which to sell goods and a hard place from which to carry on an export trade in competition with those nations which we perforce must help.

Our foreign indebtedness can be paid only in goods in the production of which war-stricken nations may resume their place in the work of the world and the less burdensome conditions for which we yearn may return.

Already the peanut growers of Alabama insist upon restrictions to the import of the Oriental legume and its oil pending the alignment of the anachronism of Protection.

America is through with paternalism, the half-brother of communism, and stands four-square to all the winds that blow in the heritage of the attainments of her technical men.

The Production of Edible Oils

A Description of the Procedure and Economics of the Baskerville Process

EDIBLE oils are one of the most important classes of foods. They are liquid fats; the three fundamental constituents of foods being proteins, fats, and carbohydrates (sugars). Lack of fats played a prominent role during the Great War, the Central Powers feeling the need of them most seriously. Since the Armistice was signed, the urgent demand for fats as foods was reflected in advanced prices from which at the present time there has been much recession. More fats than are now produced are needed, so numerous efforts have been directed toward securing new sources of supply. Some novel sources of edible oils thus have been discovered, but as yet the production therefrom has made no appreciable impression. A process, therefore, which might increase the amount of the edible grade obtainable from the raw material would be a help to mankind.

Composition of Fats and Oils

Fats (which include oils) are widely distributed in the vegetable and animal kingdoms, and, referring to the former only for the time being, we may say they are primarily glycerides of oleic, linoleic, palmitic, and stearic acids. These fats are found mainly in the reproductive organs of plants; carbohydrates, proteins, and other substances derived therefrom, as gums, etc., are present in oils obtained from these sources. These oil-containing bodies invariably contain some coloring matter. While the prominent pigment is chlorophyll, the normal coloring matter of plants, there are also several pigments more or less soluble in the cell sap, namely, carotin, yellow to red in color, and xanthophyll, a neutral body, yellow to orange in transmitted light. These substances may be destroyed by the action of such powerful agents as concentrated sulphuric acid, especially if heated in the presence of oxygen.

Closely related to the fats is a group of substances known as phosphatides or lecithins. Occurring in egg-yolk to about 9 per cent. they are found to the extent of from 0.25 to 1.75 per cent. in cereals and leguminous seeds, hence they appear in the oils extracted from the seed. They are glycerol esters, two of the acidities being neutralized by fatty acids, the third being saturated by a combination of phosphoric acid and choline, and are easily broken up by lipase, and hydrolyzed by boiling with alkalis and acids.

A small quantity of unsaponifiable residue is found in fats. In the main this is composed of the monohydric alcohols, cholesterol and phytosterol, the latter now being a generic term for a group of allied substances, sosterol and stigmosterol. Cholesterol occurs in the bile, brain and blood of animals. All vegetable fats contain phytosterol, the amount varying from 0.1 to 0.3 per cent., being even higher in the oil obtained from certain peas and beans, especially Calabar beans.

The oils are extracted by disintegration of the mass involving a disruption of the oil-sacs, (a) with a suitable solvent, (b) by rendering with heat, with or without water, or (c) by pressure, mechanical, applied when the mass is cold or hot.

Character of Objectionable Impurities and How Introduced

If the mass extracted be clean and fresh, the oil obtained is usually neutral and "sweet." The exigencies

of commercial operation do not admit of these conditions, however, so the oil usually is acid and more or less contaminated. The contaminations may be quite normal and natural. They may be bacterial in nature and also contain the very interesting substances known as enzymes (lipase, for example) which induce hydrolysis; that is to say, they will cause any water present to disintegrate the fats (and other bodies) into simpler bodies. This may be facilitated by exposure to air and light, so that a freshly-expressed oil that is sweet may soon acquire an unpleasant odor and taste. In some cases, it becomes rancid, but in all cases the oil develops acidity, and the amount of the acidity of a particular oil is a function of the time, temperature, and exposure to oxygen and moisture.

Acidity of Oils

Under usual manufacturing conditions these changes take place within the oil-containing bodies, so that freshly-produced oil is usually acid, which acidity increases on keeping. The enzymes are "killed," or decomposed, or at least their activity ceases, when they have been exposed to a temperature of about 200° C. It has not been considered a good procedure to heat the oil to such a temperature immediately after its production. Sugars and other substances present are charred or scorched at that temperature and darken the oil. If these substances be removed from the oil, it then may be heated sufficiently to "kill" the enzymes, thus improving the keeping qualities, without darkening the oil.

Composition of Pure Oils

As stated, oils and fats are chiefly glycerides of the saturated palmitic and stearic acids, with variable amounts of arachidic and myristic acids, associated with the fatty acids of several unsaturated series, e. g.,

- (1) Oleic acid, $C_{18}H_{34}O_2$, type $C_nH_{2n-2}O_2$
- (2) Linoleic acid, $C_{18}H_{32}O_2$, type $C_nH_{2n-4}O_2$
- (3) Linolenic acid, $C_{18}H_{28}O_2$, type $C_nH_{2n-6}O_2$
- (4) Clupanedonic acid, $C_{18}H_{26}O_2$, type $C_nH_{2n-8}O_2$
- (5) Ricinoleic acid, $C_{18}H_{34}O_3$, type $C_nH_{2n-2}O_3$

The last is an hydroxy acid, which undergoes a particular polymerization under suitable conditions.

"Drying" of Oils

Most fatty oils, on exposure to the air, tend to thicken, due partly to oxidation and partly to polymerization, or both. Oils may be classified according to their drying qualities and tendency toward resinification. These properties play an important part in their utilization in the arts; and their treatment in refining is therefore materially affected by the time which may have elapsed from actual production to their refining. For example, a freshly-produced linseed oil may be profitably refined by a process which is inapplicable to an "aged" oil.

Oils as Solvents

Oil normally is a liquid, and displays the phenomena of solution, precipitation, suspension and deposition usually associated with a liquid. Finely-divided, invisible substances, not small enough to be in actual solution, will remain suspended in a liquid for long periods of time. They are called *colloids*. By various means, as heat, addition of an acid, alkali, or a salt, by

the influence of an electric current, or by the addition of other colloids, these very finely-divided substances may be caused to agglomerate; that is, they may be converted into particles of sufficient size to be separated from the fluids by means of a filter. Exactly the same has been found to be true of oils.

Contaminating substances may be either in suspension, in solution, or may exist in a colloidal condition in the oil.

Impurities to Be Removed to Render Oil Edible

Crude vegetable and animal oils, therefore, contain a variety of impurities traceable to a great variety of causes. The character of the crude oil depends not only upon the kind and part of the vegetable or animal structure used, but upon the quality of the raw material at the time of expression or extraction (rusting, rotting, fermentation, sprouting, heating, etc.), the method followed, the care exercised in the process, and the conditions to which the oil is subjected prior to its refining. In many cases metallic soaps are present in the crude oil, which soaps have resulted from an interaction of decomposition products of the oil and the rendering vessels.

No Universal Method for Refining Oils

No universal method for refining animal and vegetable oils is known. A number of processes have been proposed, patented, or kept secret during the last 130 years. Around the capacity of the successful oil-refiner not a little mystery still obtains. Only within recent years has refining edible oils become understood from a scientific point of view. Each individual oil presents its own problem. Even treatment of oils of the same source obtained under different conditions, involves judgment, based on knowledge of the chemistry involved, to secure the most results. Furthermore, the uses of the oils must be considered, e. g., one wants acid oil for some paints and neutral oils for foods.

Common Methods of Refining

Four general methods for refining oils have been and are practiced. They are:

I. Treatment with steam (plain or superheated) whereby some coagulation results and many odoriferous substances are expelled. Free fatty acid content of the oil so treated is not reduced.

II. Treatment with variable amounts of concentrated sulphuric acid under determined conditions of heat and agitation with or without air. The oil contains certain substances, which, when flocculated by acid and heat, fall down and mechanically (a term used in several recognized authoritative books) carry down other impurities. This process does not diminish the free fatty acid content of the oil.

III. Heating under carefully regulated temperature conditions with fuller's earth, bone-black, etc., and filtering. This process also yields an acid oil, especially if the original oil be acid, which, in commerce, it invariably is.

IV. Adding caustic alkalies, or alkaline earths of an amount and strength determined by laboratory test, heating to the "break," settling and drawing off the oil, which floats upon the soap stock or "foots," resulting from the combination of alkali and free fatty acid. This was supposed to give a neutral oil, but not until it has been washed several times with water.

Refining With Caustic Alkali

The last mentioned of these methods has been the customary practice for refining vegetable oils for food purposes. In more detail, it depends upon neutralizing the free fatty acids in the crude oil usually by agitating the oil with an aqueous solution of an alkali, the strength and the amount having been previously determined by laboratory tests, agreed upon as a standard, and then

heating the mixture during agitation to a suitable temperature until the oil "breaks." The mass is then allowed to stand until the "foots" settle to the bottom of the kettle, when the supernatant oil is drawn off by means of a swivel siphon.

According to the process of Chisholm, sodium silicate also is added with the caustic to facilitate the settling. Invariably some "dreg" floats on top of or remains suspended in the oil. If this be great settling is sometimes facilitated by throwing salt on top of the oil in the kettle while the oil is still hot. The salt drags down some of the floating "dreg." In any event, the oil drawn off is clouded, perhaps on account of the presence of some dissolved soap or globulated moisture or suspended matter—all doubtless colloidal in nature. This oil is then "brightened" after drawing off by throwing in small amounts of fuller's earth, heating again with stirring and passing through a filter-press. Sometimes, previous to this treatment with fuller's earth, the decanted oil is heated to 160° to 180° F., in a separate settling tank to cause the "foots" remaining in the oil to rise to the top, when it is skimmed off.

Economic Factors in Other Processes. Inevitable Losses

The time factor (6 to 12 hours) in settling of the "foots" materially affects the completeness of the separation. Coconut oil sometimes requires 48 to 60 hours to settle. In any event, the "foots" is wet with oil, both of which go to form soapstock, which commands a much less price than refined oil. During the rush season the efficiency of yield of refined oil must be sacrificed to speed and output. The more speed in refining, the more loss of refined oil by the process just outlined.

Economic Essentials of Any New Process

A process which would reduce the amount of oil entrained in the "foots" to a minimum, thus increasing the yield of refined oil, and one which would not be dependent upon the slow subsidence of the "foots," i. e., admit of rapid separation with consequent increase in capacity of a refinery, therefore would approximate the highest efficiency one might hope for in such an industrial operation.

Such was the problem Prof. Charles Baskerville, Director of the Department of Chemistry of the College of the City of New York, set out to solve. Numerous researches prosecuted intensively for several years brought a successful solution. He has secured patents covering the process in the United States, Canada, France, Great Britain, Japan, and Newfoundland. The aims accomplished were:

1. Reduction of the amount of oil entrained in the "foots," thus increasing the yield of the "whole" oil.
2. Reduction of time of contact of the excess alkali, necessary for the "break" and to secure the best "color," to a minimum.
3. Utilization of the by-products.

Kinds and Grades of Oils Amenable to Treatment

Various kinds of crude vegetable oils, as corn, peanut, cotton seed, coconut, soya bean, sunflower, palm, alfalfa seed and rape seed from various sources, United States, Canada, Japan, France, England, Philippine Islands, China, etc., procured under various (extreme) condition, cold and hot pressed, extracted, burnt seed, tank cars contaminated with tar products, tank steamers contaminated by petroleum, etc., have been refined by this process. In fact all crude vegetable oils submitted have been refined by this process. Some very low-grade oils which cannot be refined by other pro-

cesses, and these are suitable only for the soap kettle, have been refined and yield edible oils by this process. This has been done with a very low-grade cotton seed and soya bean oils. The economic importance of this readily will be appreciated.

China wood oil, of great value in paint and varnish manufacture, is not refined by this process; nor are castor oil and aged linseed oil. Fresh linseed oil, however, has been refined commercially.

By this process also such animal oils as codliver, menhaden, salmon, dogfish and whale oil also have been refined. These as a rule, however, require a preliminary treatment for the removal of characteristic contaminating material acquired in the more or less crude production of such oils.

Decrease of Loss in Refining

To accomplish the first two aims referred to, it is necessary to get the "foots" into such condition that it may be filtered and then compressed to reduce the amount of adhering "whole" oil. By doing this immediately after the "break" and while the oil is still hot, time is saved, heat conserved and saponification of "whole" oil by the necessary excess of alkali present to secure the best color is reduced to the minimum.

Coagulation of Colloids.—Some colloids may be and are coagulated by heat, some by acids, some by alkalies, some by salts, and in time will settle out. Some colloids that have been coagulated, or lumped, may be filtered from the liquid menstruum. Some coagulated colloids in their formation absorb coloring matter.

Mating Impurities.—Suitably prepared cellulose fibre will absorb some coloring matter. It will bring about an agglomeration of the material precipitated from oils by treating the oil with alkalies and heating, and it will bind the particles together so that they lose their somewhat slimy character and permit separation by filtration. Short-fibred "linters" or "delint" is a suitable form of cellulose for some oils.

Therefore suitably prepared cellulose is added along with the caustic to the oil to be refined. The "break" takes place normally in such a physical condition that the soaps and other constituents of the precipitate thus produced may be separated from the oil immediately by filtration. However, it was determined that some of the soaps formed by neutralizing the free fatty acids with the alkali tended to emulsify with the oil, or so to distribute themselves by colloidal solution, as to render their separation difficult.

Filtration.—This was overcome completely by subjecting the oil, at a suitable stage of the treatment, to the action of an anhydrous salt which is capable of taking up water of crystallization, the preferred salt being dry sodium carbonate (soda ash), which, as is well known, is capable of taking up water of crystallization, according to temperature conditions. By such treatment the soaps which already have been formed by treatment with caustic alkali, and which have become so incorporated with the oil as to be incapable of complete separation by ordinary filtration, are hardened or pectized, presumably by dehydration, and are so modified that they are readily separated by simple filtration. Sodium sulphate, which acts in the same way, may be used instead of soda ash. These dehydrating chemicals produce no change whatsoever in the composition of the finished oil.

Procedure of Process

The process is carried out by adding ordinarily 2 per cent. of prepared cellulose (less than 1 per cent. real

cellulose) and a suitable amount of caustic soda, usually much stronger but actually less in amount than is commonly used. The whole is thoroughly basted by mechanical means and then heated to 45-65° C. to produce the "break"; a determined amount of soda ash is added, after which it is filtered. At first some soap may pass through the filter-cloths. In that event, the first filtered oil may be run directly back into the refining kettle and pumped through the press until the oil is "bright." This usually occurs within a few minutes; in fact, the speed of filtration is directly dependent upon the speed of the pumps. This re-filtration also improves the color. This oil is neutral and can be deodorized and bleached, or both at once, or may be stored safely. If linters is used, one-fourth to one-half per cent. of the dry cellulose is added.

The process is operating commercially at present in the United States on corn, peanut, and soya bean oils. A new factory has just been constructed to operate with peanut, soya bean, and cocoanut oils. Negotiations are under way for six other plants to be operated in the United States, as well as plants in Great Britain and Japan.

Advantages

The advantages claimed for the purpose are:

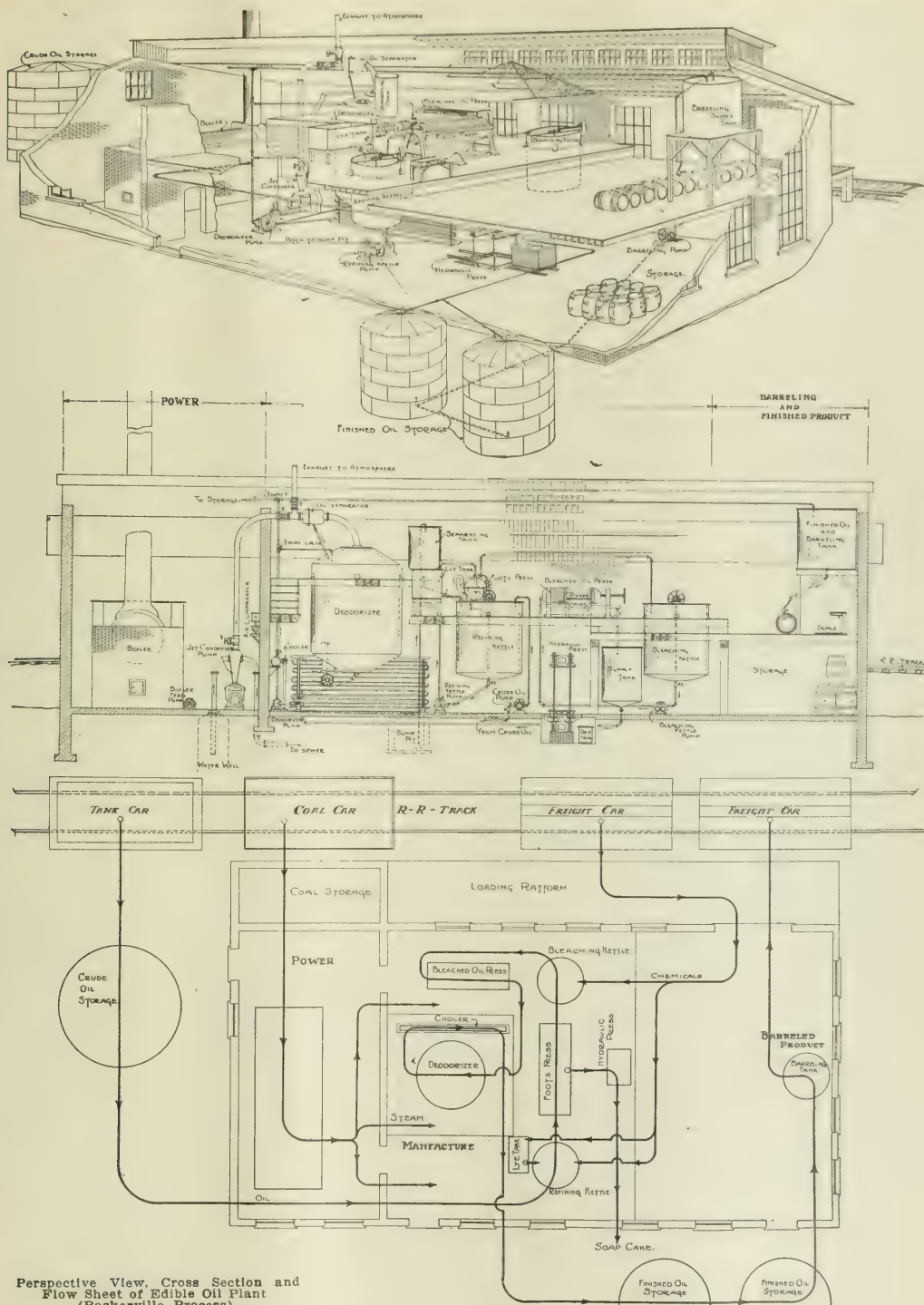
- (1) Speed in handling oil, allowing the oil to be exposed to elevated temperature a minimum length of time.
- (2) Speed, which admits of quick turnover.
- (3) Speed, which doubles the capacity of a refinery, or quadrupling the capacity on a 24-hour basis.
- (4) Increase of yield of refined oil; 1 to 15 per cent., depending upon the oil.
- (5) Ability to refine a very low-grade oil, yielding an edible product from raw material which cannot be refined by other processes.
- (6) Conservation of heat, if the oil is to be bleached and deodorized, hence less fuel.
- (7) It gives a double check on the refinery by weighing the finished oil and cake.
- (8) A further saving of whole oil to the extent of 1 to 3 per cent. is made possible by having the "foots" in the form of a filter cake, which is subjected to hydraulic pressure.
- (9) Little new machinery is needed beyond that of a refinery by the old process; extra filter presses, a hydraulic press, a breaker and cutting tank, with piping and pumps being practically all that is needed.
- (10) The cost of chemicals is the same or less.
- (11) The labor items cost no more or less.
- (12) The by-product may be converted directly into a useful and commercial material.

All the claims have been verified on a commercial scale. For example, at one plant it is the common practice to filter two and a half tons of corn oil in fifteen minutes. Ten tons of soya bean oil in another plant have been filtered immediately after the "break" in twenty-six minutes. In fact, commercial practice has shown greater saving than was claimed as a result of the laboratory practice.

Objections Raised and How Met

The only objection to the process that has been seriously raised is based upon the presence of cellulose in the filter or press cake. This cake corresponds to the "foots" of the old process. The "foots" went directly to the soap kettle or was cut with acid and sold as black grease. The soap maker ordinarily does not want cellulose or linters in his soap stock. However, the press cake may be cut by acid or niter cake, and the linters removed by simple filtration. The product is black grease similar to that obtained from "foots."

Another objection is the slightly greater cost of chem-



Perspective View, Cross Section and Flow Sheet of Edible Oil Plant (Baskerville Process).

icals used in the first stage of the process. This is cared for by credit for the excess used in the by-product.

Complete Utilization of Materials Used

If paper pulp (cellulose) be used, then soda ash may be employed as the dehydrating agent and the whole cake goes into the soap kettle. The soda ash used co-operates with the necessary extra caustic soda needed for making soap. The caustic soda used in converting the cake into soap dissolves some of the cellulose and mercerizes some. If this soap-stock be concentrated with more soda ash to produce a soap powder, the cellulose used acts as a filler and serves as a detergent in the same way as sodium silicate, a constituent of many soap powders. Thus, everything used in the Baskerville process may be converted into a product commanding a price, equal to or superior to the costs of the raw material.

Recovery of Whole Oil from Soap Stock by Other Methods

The desirability of recovering whole oil from the "foots" has long been recognized and numerous efforts have been but forth with that end in view. Heretofore, the best method cotton seed oil specialists and engineers in the United States have been able to devise has been to give centrifugal treatment to a water emulsion of the soap-stock.

Centrifugal Method

In general, this process comprises dissolving soap-stock in about four parts of water to one part of soap-stock and subjecting it while warm to the action of enormous centrifugal force in a specially designed super-centrifuge, whereupon a considerable portion of the oil present is forced out of the soap-stock solution in the shape of an emulsion, which emulsion is subjected to the action of further super-centrifuges after being agitated with a concentrated brine solution, whereupon these second-run machines deliver oil itself and brine nearly free from oil. The action of the super-centrifuge is continuous except for shut-down periods to remove any sediment from the bowls.

The recovered oil then can be returned for refining. It will be about equal in quality to the original crude oil from which the soap-stock being treated was made, provided this soap-stock is handled from the refinery through the centrifugal plant within a short time after being made.

The resultant soap-stock solution which flows from the machine for treatment therein will be too dilute for sale as such, but can be reduced readily to acidulated soap-stock by boiling with the proper amount of sulphuric acid or niter cake.*

Efficiency of Centrifugal Method in Comparison with the Baskerville Process

The commercial recovery of the centrifugal process is 60 to 64 per cent. of the whole oil in the "foots." On an 8 per cent. refining loss the recovery is 1.55 lbs. of oil per 100 lbs. used. This oil requires refining, as if it were the original crude oil.

By the Baskerville Process from two to three pounds of refined oil per 100 pounds used, is obtained at once. Upon grinding up the press cake, mixing with water as indicated above, and giving the solution one filtration through a very small press, such as used for polishing oil, the filtrate then may be subjected, if desired, to

the centrifugal process with a further recovery of 60 per cent. of the whole oil.

Relative Profits by the Two Processes

The total investment for the centrifugal process to treat the "foots" from 20,000 tons of oil per season, requires 14 to 18 machines and the investment of \$50,000 to \$60,000 outside of cost of ground and buildings (December, 1919). The estimated net profits by such process on the amount of oil mentioned at 20 cents per pound is \$48,400. The Baskerville process yields a net profit of \$160,000 per year on the same amount and kind of oil on an investment of one-half.

Estimates of Profits by Baskerville Process

The following is an estimate of the profits for a plant to refine cocoanut oil in the New York district. This estimate is based upon actual figures from a plant using the Baskerville Process.

ESTIMATES OF PROFITS IN REFINING COCOANUT OIL IN THE METROPOLITAN DISTRICT.

Assumptions: Oil to be brought alongside plant in steamers, to be sent out in barrels, and to contain 5 per cent. free fatty acid.

Refining Costs: Five per cent. free fatty acid cocoanut oil gives 7 per cent. refining loss.

At 7 per cent. refining loss, there would be 140 lbs. per ton of oil to go into free fatty acid. It is estimated that of this amount 110 lbs. could be recovered as free fatty acid.

Two per cent. of salt cake to be used. This calls for 40 lbs. of salt cake at .02 per lb. = \$0.80.

With 5 per cent. free fatty acid, there would be required 14 lbs. of caustic soda per ton. At 4½¢. per lb., this would cost 63¢. per ton for caustic soda.

Estimate linters at 1 per cent. of weight of oil, or 20 lbs. per ton. Linters to cost 5¢. per lb., or \$1.00 per ton.

Fil-char to be used for bleaching, using ½ of 1 per cent.

Fil-char at ¾ of one per cent. would require 9 lbs., and at 10¢. per lb., would be equivalent to 90¢.

Estimated loss of oil in bleaching at 3 lbs. per ton, and value of the oil at 22¢. per lb. = 66¢.

Coal consumption, including deodorizing, runs at the rate of \$1.00 per ton of oil refined, with coal costing \$7.00 per ton.

RESUME OF CHEMICALS AND COAL COSTS.

Coal	\$1.00
Caustic soda	.63
Linters	1.00
Salt cake	.80
Fil-char	.90
Loss of oil in fil-char	.65
	\$4.90

The total refining costs are based upon the operations of a small plant, and should be lower in a plant of practically double the capacity.

Costs per ton are based upon several months' operation of the plant, and converted into costs per ton of oil refined. A plant refining three to four times as much should, of course, better these cost items, especially the items of general administration and executive expenses.

Deodorizing. It would be noted in the above resume of the costs involved, that deodorizing is included. H. E. Brown, chemical engineer, of New York, who has installed the Baskerville Process in several plants, has devised a special deodorizer of high efficiency. This deodorizer may be used with neutral oils refined and bleached by any process.

RESUME OF REFINING COSTS PER TON.

Sales commissions	\$2.42
Office expenses	.50
General administration expense	3.70
Chemicals	4.00
Royalty	2.00
Wages	4.50
Coal	.90

\$18.02

* *Chemical Age Press*, December, 1919; report by F. I. Gibson, general superintendent, Southern Oil Company, Savannah, Ga.

PRICES OF COCOANUT OILS.

New York, August 16, 1920, quotations.

Edible cocoanut oil in bbls.	.18
Crude in tanks (5% free fatty acid) ..	.14

PROFITS ON 50 TON PER DAY PLANT.

Income Account.

1,860 lbs. refined oil at 18c.	\$334.80
Free fatty acid, 110 lbs. at 12½c.	13.75

Total income \$348.55

Cost Items.

2,000 lbs. crude cocoanut oil at 14s.	\$280.00
Bbls. per ton	20.00
Refining costs as itemized above	18.02

\$318.02

\$348.55 — \$318.02 = \$30.53 or 1½c. per lb. net profit.

At 50 tons per day this would be equivalent to \$1,500.00 per day.

ITEMS OF COST TO ONE TON OF REFINED OIL FROM ACTUAL FACTORY OPERATIONS.

Coal	\$.868
Chemicals	.934
Labor	4.527
Sundry expenses	1.155
Sales account	3.87
Royalties	2.00
Overhead	3.62

Total cost refining, bleaching, deodorizing oil per ton \$16.974

If oil is shipped in bbls. add 20.00

For total costs producing edible oil in bbls. per ton \$36.974

The present differentials between crude and finished oils is 5c. to 7c. per lb., leaving a net profit per ton of \$40 to \$60 per ton and on 50 tons per day, equivalent to \$2,000.00 to \$3,000.00 per day.

The Charcoal Method of Gasoline Recovery

By G. A. Burrell, G. G. Oberfell and C. L. Vores

THIS year there will be produced approximately three hundred millions of gallons of natural gas gasoline. Compression, refrigeration and absorption methods have been used with casinghead gas, while oil absorption has been the only really successful method employed to recover the gasoline from what is known as dry gas.*

In absorption plants the gasoline vapors in natural gas are dissolved in a liquid-absorbing media, such as mineral seal oil, and later recovered by distillation. In compression plants the natural gas is compressed to pressure up to 350 pounds per square inch and cooled, whereupon the gasoline is precipitated. Some plants are combinations of compression and absorption methods.

Difficulty is experienced in marketing the product from oil absorption or compression plants because of high evaporation losses. It is apparent that a method whereby a sharp fractionation can be obtained will eliminate much of this trouble. Methods of hot blending and steam treatment have been used with varying success, but there is still much room for improvement.

The Charcoal Process

The charcoal process consists of bringing the gas into intimate contact with activated charcoal, whereby the recoverable vapors are retained and the denuded gas allowed to return to the distribution lines. When a predetermined saturation of absorbed gases has been attained in the charcoal the gas is allowed to come in contact with a fresh supply of charcoal. The vapors retained in the first mass of charcoal are then recovered by heating the charcoal with superheated steam. Most of the vapors are condensed in water-cooled condensers and then blended and stored preparatory to marketing.

The Charcoal

The charcoal best suited to the successful operation of the process is made from cocoanut shells by the steam activation process developed during and since the late war. Charcoal made previous to the war did not possess sufficient absorptive power to make it useful for this work. Suitable charcoal must be capable of collecting, condensing and holding large quantities of gasoline during the absorption.

The size of the charcoal granules should be around 8-14 mesh. Smaller mesh material has slightly greater absorbing qualities, but the resistance to the gas passage rapidly increases as the size of the granules decreases. Gas flowing through a column of 14-mesh charcoal 5 feet in depth at the rate of 40 cubic feet per hour per square inch of base surface and flowing against atmospheric pressure will show a retardation of from 1-2 pounds per square inch.

Absorption

Heat plays a very important part in the absorption of gasoline by charcoal. When gas first comes into contact with charcoal at atmospheric temperature considerable heat is produced, due to the latent heat being given up by the condensing vapors. After a few minutes this is no longer noticeable because selective absorption takes place. Much of the heat revolatilizes the lighter vapors which are not desired in the final product. Some experimenters have stopped when no more heat evolution was noticeable thinking that absorption was complete.

The temperature of the charcoal at the beginning of the gas passage is not very important when using gas of low gasoline content. It quickly gains the temperature of the incoming gas. However, the temperature of the inflowing gas is very important. The curve of recoverable efficiency is a straight line function of the temperature reaching its zenith at 300° C. Above that temperature there is no recovery.

The rate at which absorption takes place varies according to the richness of the gas mixture. For gas yielding 400 gallons of gasoline per million cubic feet, a rate of 40 cubic feet per square inch of base surface in a 5-foot column of charcoal is not too high a rate. Above this rate the back pressure is too high.

The volume of gas to be passed is determined by the nature of the product desired by the operator. If he desires a very volatile product a low saturation of the charcoal may be carried so as not to allow the selection to eliminate too much of the butane hydro-carbons. If a more stable product is desired a higher gas rate is used.

Distillation

After the absorption has been completed it is necessary to expel the absorbed vapors from the charcoal.

*Paper presented at meeting of the American Chemical Society, Chicago September 1920.

This is done by the application of superheated steam directly to the charcoal. The temperature of the superheated steam should be as high as local conditions will allow. There will be a decrease in fuel per gallon of gasoline recovered as the temperature of the superheater steam is increased up to the point where radiation losses become so large as to interfere. Local conditions affect this to a great extent. It will be found, however, that under ordinary conditions 500-525° C. may be maintained with good results.

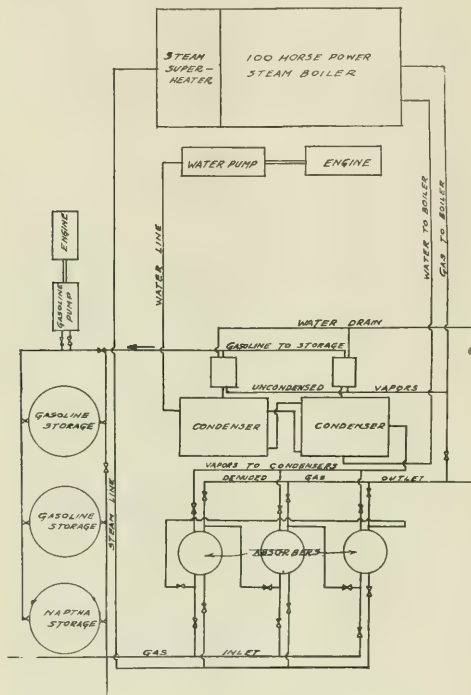


Diagram of Charcoal-Absorption Gasoline Plant, 1,000 Gallons Per Day Capacity.

The amount of steam required depends upon the percentage of the available heat utilized. The charcoal must be heated to 300° C. to expel the heavier fractions of gasoline. This temperature also insures an active absorbent. The available heat consists mainly of the superheat. The specific heat of steam at around 35 pounds pressure is about 0.48, while the specific heat of the activated charcoal is about 0.28. Calculations show that theoretically about 18,000 B. T. U. are required to produce a gallon of gasoline when the saturation of the charcoal is 15 per cent.

The question is asked repeatedly: "Does this steam distillation injure the charcoal for other absorptions?" The steam distillation does not injure the absorptive capacity. In fact, it leaves it in better condition than dry heating leaves it.

A sample of charcoal which has been exposed to the air for a month was divided into two equal portions. One portion was heated to over 500° C. in an open vessel for over two hours, while the other was treated to 300° C. with superheated steam. The portion

treated with superheated steam exhibited an absorption curve which reached its peak later and showed more retentivity than the dry heated sample.

Condensation

The gasoline vapors driven from the absorber and the steam may be condensed in any type of condenser preferred. We prefer two water-cooled condensers in series. The cooling water around the first condenser can be circulated just swiftly enough to condense the major portion of steam and allow for its being trapped away without being cooled much under the boiling point. In many localities this condenser well may be an air condenser with enough of the line jacketed to heat the boiler-feed water.

The second condenser must be an efficient one. With cooling water at 15° C. or thereabouts very efficient condensation will take place without the use of pressure above atmospheric.

The condensed gasoline and water flow from the condenser, together with the uncondensed vapors, into a separating tank where the separation is accomplished by the difference in the gravity of the materials to be separated. If it be desired to blend the final product with naphtha to reduce its gravity that also may be done at this point. We prefer to blend with from 10-15% naphtha of about 56° Bé.

Quality of the Product

A study of the qualities of the gasoline produced has brought to light the fact that the gravity and vapor tension of this gasoline is less than the gravity and vapor tension of that made from the same gas by either compression or oil absorption. There are several reasons for this. In the first place, conditions under which the condensation is made affect the character of the final condensate. It already has been noted that the gasoline is condensed under atmospheric pressure only. This is in direct contrast to the methods of condensation used in the compression process where the pressure generally ranges between 90 and 250 lbs. When the gasoline is put in storage or released from the high pressure evaporation will begin immediately. During evaporation much of the good gasoline is carried along mechanically and lost along with the undesirable wild vapors.

The method by which the condensation is carried on is also an important factor in determining the character of the condensate. The charcoal process is a "batch" process. By this is meant that consecutive distillations of a series of absorbers take place instead of continuous distillations in a single still. This drives out the lighter vapors first and allows the application of the blending naphtha to the material that actually needs blending. If there are any wild vapors left in the charcoal they are driven out first by the lowest temperature and do not come into contact with the salable gasoline at all. By the oil absorption method, which is a continuous process, all fractions are driven out together and carried to the compressors together. Here the salable vapors are condensed in the presence of the wild vapors so that all the salable liquid must be saturated with wild vapors at the temperature and pressure used.

A third reason for the better quality is found in the method of absorption itself. We have already mentioned "selective" absorption. This property of selection gives clear-cut fractionation which easily can be regulated by the operator. Practically all wild vapors are eliminated in the absorber itself, thus preventing

their interference with the condensation and their absorption by the condensed vapors.

Experience has shown that the product from our plants has three pounds less vapor tension and 10° less gravity than gasoline made by an oil absorption plant from the same gas.

When the standard Bureau of Mines distillation test is applied to the gasoline produced by the different methods, much information is secured. The initial boiling point of both compression and oil absorption gasoline is from 5-10° below the initial boiling point of the charcoal gasoline. The final boiling points and the residue are practically the same. The curves of these distillations show that the greater gain in yields is in the recovery of that product boiling between 30-70° C., or within the range of the pentane and hexane hydrocarbons. About 73% of the charcoal absorption gasoline is within this class. Approximately 33% of the compression and 38% of the oil absorption are condensed between these temperatures.

Tests also showed that 93% of the charcoal absorption gasoline is recondensed after the standard Bureau of Mines distillation while approximately 66% of the oil absorption and 63% of the compression material is recovered. None of these samples were blended before they were tested. The oil absorption sample was made under a final pressure of 90 lbs.

Yield

The yield is not sacrificed at the expense of quality. A direct comparison between an oil plant and a charcoal plant operating on very lean gas showed that the oil plant averaged around 125 gals. per million cu. ft. of gas and had a weathering loss of 20 to 30 gals. before shipment. The charcoal plant produced 180 gals. from this same gas on the same days. There was very little wild vapor in the product.

The problem of contact, bringing every particle of gas into intimate contact with oil capable of absorbing the commercial vapors, has always been an important one. Many kinds of baffles and sprays have been tried with varying degrees of success. With an absorber packed with 8 to 14-mesh charcoal there is no difficulty in securing proper contact for complete extraction.

The actual absorption of the vapors by a solid medium is governed by conditions other than those governing the absorption by a liquid. It is the capillarity of the charcoal which makes the absorption possible. The vapors are held and liquified in the capillaries.

The oil absorption process is merely a modification of the compression process which consists of concentrating the recoverable vapors before applying the compression. But by the compression method it is possible to condense only a certain part of each fraction included in the gas. This part is determined by the number of fractions present, by the percentage of the different fractions present and by the temperature and pressure employed. It is only a specific application of the partial pressure laws. Air or any gas not condensable works against efficiency.

The Plant

Suitable apparatus to practice the charcoal absorption process will include three essential units, viz., a power unit consisting of a boiler equipped with a superheater, an absorber unit consisting of at least three absorbers or charcoal containers, a condenser unit consisting of cooling coils and a separation and blending tank. Storage tanks, gasoline and water pumps and loading equipment must be supplied with any system as occasion demands.

The ordinary oil absorption plant must have in addition to the above named units, stills, vent tanks, oil storage tanks, tail gas compressors, oil pumps, vapor heat interchangers, oil heat interchangers and compressor cooling coils.

In the accompanying diagram appear the essential features of a charcoal gasoline plant.

In conclusion it can be said that a charcoal plant costs less to install, is cheaper to operate and produces more and a better grade of gasoline than do compression or oil absorption plants.

American Agricultural Chemical Co.

In his report of the business of the American Agricultural Chemical Co. for the fiscal year ending June 30, Peter B. Bradley, president, says that the gross sales of the company showed an increase of 17½ per cent. over the sales of the previous year, and would have been still greater had it been possible to secure sufficient labor at all the plants and adequate car service for the transportation of raw materials and manufactured products.

The net profits for the year were somewhat curtailed in consequence of the prices ruling during the fall of 1919 being inconsistent with the increased cost of materials, labor, transportation and supplies, so that the fertilizer business for the first half of the fiscal year resulted in a considerable net loss over the actual cost of production. Prices for the spring trade, however, were readjusted to a basis more in accord with the cost of production, and as the demand for fertilizers and by-products was excellent, the company was enabled to earn its regular dividends of 6 per cent. on the preferred and 8 per cent. on the common stock and carry \$1,024,828 to surplus.

No process has as yet proven commercially successful in obtaining adequate supplies of fixed nitrogen from the air suitable for agricultural purposes. We are therefore still dependent upon Chilean nitrate, ammonium sulphate and various forms of organic ammoniates for our principal requirements of nitrogen, the average cost of which has advanced about 100 per cent. since 1914.

The cost of mining rock phosphate and of all other items into the manufacture of our fertilizers has advanced to such an extent that our present average cost of production a ton of fertilizer has nearly doubled since 1914. Our floating debt has naturally risen in consequence, though this increase is more than offset by the increase in quick assets, which exceed our entire indebtedness, including all bonds outstanding, by more than \$25,000,000.

The current demand for our fertilizers bids fair to tax our facilities to their utmost capacity, orders already in hand for the fall trade being far in excess of those received during the same period of last year. Our "other than fertilizer" business is also constantly increasing and has become an important contributor to our income.

The traffic on the Charlotte Harbor and Northern Railway, owned and operated by us in Southern Florida, has grown to such an extent that a large addition to the rolling stock has recently been ordered.

The company is now operating 39 fertilizer plants, 15 by-products plants and 3 phosphate mining plants, and has more than 55,000 local agents. There are over 13,000 stockholders of record, of whom more than one-half are women and trustees.

A Review of Conditions in the Fertilizer Industry

By E. G. McCloskey

Soil Improvement Committee, National Fertilizer Association.

WITH the fertilizer industry, just as with almost every other industry in this country and the world, the first year of peace brought forth more difficulties and produced more pitfalls than during any of the years of the war. Part of these difficulties are due, no doubt, to the changed conditions of our lives and business brought about by the great world conflict. Most of them hark back in the fertilizer industry to a shortage of raw materials and labor.

The United States "Plant-food Dependent."

The United States has never been self-supporting in its plant-food supplies. In 1914 this country was importing 80,000 tons of sulphate of ammonia a year from Europe; about 260,000 tons of nitrate of soda was imported from Chile for use in fertilizer alone, and practically all our potash came from Germany. Even with our own "home plant-food," phosphoric acid, we were not absolutely independent. We had and have the raw phosphate rock in almost unlimited supply, but this phosphate rock must be processed by sulphuric acid to render available the plant-food it has in it, and much of the raw materials from which the sulphuric acid is made was imported.

Not only did the war cut off many of the sources of supply of raw materials but it became an active competitor for the available supplies. Sulphate of ammonia, nitrate of soda, and potash salts are plant-foods and they are cannon food as well, so much so that the government took over the entire supply and rationed it out. Fertilizer was necessary to the successful operation of war because food was vital, but munitions were even more necessary, and the munition plants had to be kept going. The fertilizer industry took what it could get and did the best it could.

New Sources Helped Some.

Under the stress of great need, some new plant-food materials were developed. At best, however, they only helped out. With peace and a complete restoration of trade some of these will disappear. Some will remain as real sources, though none of them produce any considerable amount of plant-food.

As against the new gains there have been permanent losses. The war operated both ways in this respect. Tankage has been found to make good cattle food and the better grades are so valuable for animals that they can no longer be used for plants. The same is true of cottonseed meal. It is only a question of time when it will disappear as a fertilizer raw material.

All this sounds like ancient history and perhaps it is in part. The war is over and peace has come but we cannot write off the effects of war as easily as we can sign an armistice. Probably our old ammoniates will come back ultimately and in larger amounts than before, but they have not done so as yet.

Our Biggest Present Difficulty.

Our biggest difficulty just now is with phosphoric acid. The acid phosphate of the trade is the largest single material which goes into the making of fertilizer in this country. Acid phosphate is made by acidulating raw phosphate rock with sulphuric acid. This phosphate rock is obtained largely from Tennessee and Florida. Tennessee formerly supplied the manufac-

turers in the Middle West; Florida those in the East.

The building of the nitrogen fixation plants at Muscle Shoals, Alabama, and munition plants at other points nearby, drew an immense amount of labor from the phosphate fields and practically caused them to close down. Fertilizer plants at Nashville, Tennessee, even had to draw on Florida for rock. Following this came a strike in the Florida field and that is being felt even now. The strike came last fall and ran for months. Even when it was settled, production did not pick up much because many of the laborers had moved out and gone to work elsewhere. The shortage of raw rock carried over into this spring and produced the greatest shortage of acid phosphate we have ever had, and it is sure to be felt in the fall trade.

The Present Potash Situation.

Everyone supposed that as soon as the war was ended we would have shipped into this country large quantities, if not enormous quantities, of potash. That has not been the case. In fact, we are now getting but little more than we have been getting from abroad since 1914, although, of course, the prospects are for steadily increasing importations from Europe.

At the close of the war we had developed here a pretty fair sized domestic potash production. In 1914 the United States consumed approximately a million tons of potash-carrying material. At that time our local production was practically nothing. In 1916, after the stimulus of war demand, American productions totaled 9,720 tons; in 1917, 32,571 tons; in 1918, 54,561 tons; but in 1919 American production was reduced to 10,000 tons.

This alarming reduction in the American-made product in the season of 1919, which, of course, is being felt in the retail fertilizer trade during the present season, was due to an unfortunate bit of misinformation.

In January, 1918, reports were sent to the United States that large tonnages of potash would be sent here as ballast in Shipping Board boats. No attempt was made to ascertain whether Alsace could spare the potash, as both France and the recovered provinces needed large quantities for spring planting, or whether it could be transported by rail, river or canal. A prompt investigation was made as to these points and it was ascertained that France could neither spare nor ship any potash to America to arrive in time for spring use. The damage had been done, however. Buyers of potash pulled out of the market and many American potash plants closed down for lack of a market.

In April, 1919, the cables had it that Germany possessed large stocks of potash at their ports and that it would come to America in payment for food. Germany did not have large stocks, and none came to the United States until July, and then in small quantities. In February, 1919, the British Government made a good sized purchase of potash from Germany for spring planting. The embargo on the shipment of potash from Germany was raised in July of 1919. From that date to December 1, 1919, only 4,500 tons of pure potash were received here, although fair sized shipments were on the water. Closed water transportation, shortage of coal for rail transporta-

tion and disorganized conditions generally account for the small shipments, and indicate clearly the unsettled conditions existing in Germany, as potash is as good as gold in payment for needed supplies. In the meantime, the Germans have advanced their prices and are now asking three and one-half times the price realized before the war.

In July, 1919, the Alsations expected to be able to ship something like 50,000 tons of pure potash here for fall and spring use. Up to January 1, only about 20 per cent. of the expected shipments had been made. Strikes, low water on the Rhine, shortage of cars, coal and other difficulties accounted for the small output.

Labor Conditions—Labor-Saving Machinery

Labor conditions in the factory, of course, are not good. This is particularly true in the North Atlantic States. The class of labor which has been needed most in the fertilizer factory is the class which is now most scarce, and which costs most in proportion to what it could be had for previous to 1914.

In the long run, perhaps, this may not be as bad for the fertilizer manufacturer as it may seem to be at first glance. A few years ago labor saving machinery was almost unknown in the fertilizer factory. Men were plentiful and wages were reasonable. Much of the work was done by hand. Piles of raw materials were picked loose by hand, shovelled into wheelbarrows, rolled to the scales, weighed and dumped into the machines. A plant shipping a thousand tons of mixed fertilizer a day would require two hundred men to put the raw materials into the machines, to say nothing of the men to mix, screen and bag it and load the cars. The scarcity of labor during the past few years, as well as the increased wage rate and the fact that labor is only one-half as efficient as formerly, has tended toward the development and introduction of labor saving machinery wherever possible.

Modern Factory Construction.

Modern practice in fertilizer factory construction consists of steel buildings, every point of which is reached by traveling overhead cranes carrying grab buckets capable of picking up two or three tons of material at a time. A row of large 10-ton hoppers stretch across the building opposite each mill. Under each large hopper is a small weighing hopper and under the weighing hopper a belt conveyor running to the mill. The cranes overhead keep the large hoppers filled with the various raw materials. The proper amount of each for each ton of fertilizer is weighed out into the small hoppers underneath and then dumped onto the belt and conveyed to the mill. With this system twenty men can easily handle a thousand tons a day into the machines, a saving of 90 per cent. of the labor.

This type of factory costs a great deal more than the old type and the few men necessary command salaries in place of wages, so there is little saving, if any, in the cost of manufacture, but it is possible to ship the fertilizer when the farmer wants it, and this is hardly possible with the old type plants under present labor conditions.

Perhaps, in the long run, the present shortage of labor may prove to have been a good thing for the fertilizer business. Certainly it has brought in labor-saving machinery and methods much more rapidly than would have happened under normal conditions.

Transportation in Bad Shape.

A serious and ever present problem confronting the

fertilizer manufacturer is that of getting raw materials into his factory and getting his product to the farmer. Getting shipment either way is a gamble at best and always a case of scramble. There is no way of forecasting what may happen. You may get cars and you may not and there is not much you can do about it either way, except to beg, plead and trust to luck.

The recent "outlaw" strike on the railroads was a climax to a year of enormous difficulty and it caught the fertilizer men, particularly those in the Northern sections, at the peak season. Ordinarily the peak of spring business comes in the latter part of March, but this year everyone was behind-hand. Northern manufacturers were behind all the rest, because they had had a winter which tied up transportation badly. About the time that they were beginning to have hopes of getting their goods out on time, along came the strike. Everyone knows what happened because everyone felt it more or less.

Car Shortage and the Fall Business

With the opening of the fall fertilizer season the transportation problem looms up as probably the biggest single difficulty to overcome. The Car Service Commission in Washington recently asked the fertilizer manufacturers to go out on a campaign for early orders and early shipments for fall fertilizers, asking that they start the shipping season on July 1—at least a month in advance of normal. The fertilizer manufacturers were perfectly agreeable to this and have been pressing their customers with the advantages of early orders and early shipments. Up to July 15, however, there has been very little accomplished, mainly because the cars were not available. The fertilizer manufacturers and railroads got together at the large shipping points and in Washington, and out of these meetings there came a ruling on July 14 from the Car Service Commission that fertilizer shippers should have "a preferential supply of 75 per cent. of actual daily requirements." This preferential ruling was as good as could be hoped for and better than was expected. Previous to this ruling the prospects were for not to exceed 50 per cent. of actual daily requirements.

With this preferential ruling, providing no more strikes occur to disrupt it, and with the shipping season starting two weeks in advance of normal, together with what may be gained through double loading and heavier loading of cars, the situation is quite hopeful. It seems, at the present time, as if the industry may come through the fall season in good shape.

To your true salesman such a situation is hopeless. Having goods to sell and no customer in sight is bad enough but there is still chance for real effort and hard work. Customers hounding your very heels and nothing to give them is calculated to shake the nerve of the most hardened traveler.

Prospects for the Future.

The bright spot on the horizon is the increasing demand for fertilizer. In the increased use of fertilizer, with the more economical crop production due thereto, the American farmer sees partial relief from his distressing labor shortage. Ruling high prices for farm products have created this demand which finds fertilizer manufacturers sold up and behind on orders. The prospects for the fall wheat trade are fully as good as was the prospect for the spring trade. There is every reason to expect that the boards will be swept clear again next fall, if, indeed, the demand can be met.

Chemistry of the Fermentation Process of Glycerine Production

THE production of glycerin by biochemical methods in Germany during the war was on such a scale that while reliable production figures are not available, it is known that large sugar stocks were withdrawn from consumption to conserve raw material for the production of this essential munition.

The principles controlling the yield of glycerin in the ordinary fermentation of sugar, which is about 3 per cent. of the weight of sugar, neither were clearly understood nor a practicable process of glycerin production from this source developed until the war provided the incentive for constructive work along these lines.*

Independently of Connstein and Lüdecke, who manufactured glycerin by the "protol" process, Neuberg studied the theory of alcoholic fermentation and evolved new methods which are considered in this article.

Principles of Aldehyde Fermentation

Neuberg's chief contribution to the art† was the discovery that formation of acetaldehyde is essential to the production of glycerin and that alcoholic fermentation of sugar can take place in an alkaline medium.

Essentially, the problem is to produce a compound with three carbon atoms, i. e., glycerin, $C_3H_5(OH)_3$, by the decomposition of a carbon chain, i. e., sugar, which yields at the same time compounds with one carbon atom, i. e., carbondioxide, CO_2 , and two carbon atoms, i. e., acetaldehyde, CH_3CO , in their respective molecules.

Study of pyruvic acid (acetyl formic) acid, $CH_3CO.COOH$, fermentation by means of the enzyme carboxylase, whereby the former was resolved into carbon dioxide and acetaldehyde, and the acetaldehyde into alcohol, aided in the solution of the problem.

Conditions determining alcohol formation are well known; those affecting acetaldehyde decomposition remained to be established. This could be done in either of two ways, viz., (1) to isolate the intermediate product and ascertain the conditions of its formation, or (2) to change the reaction so as to form new intermediate products.

The former procedure is impracticable for in the decomposition of sugar, the structure of the decomposition products is too closely allied to that of the original substance to permit of their differentiation. The latter method was more applicable as it afforded the possibility of influencing the reaction by means of acids or alkalis. As the addition of acid soon destroyed the potency of the zymase enzyme, fermentation in an alkaline solution appeared to be more promising of results.

Fermentation of Sugar in Alkaline Medium

The decomposition of sugar can be effected by the use of alkaline reagents, e. g., the transformation of hexose into methylglyoxal, acetol and lactic acid; also it has been established that zymase is more stable in alkaline media than hitherto has been suspected.

It is fundamental in the fermentation industries that the action of yeast proceeds most efficiently in an acid medium; also that if the medium is de-

ficient in acid that the required acidity is provided by the yeast until the optimum condition is attained. The acid formed is at the expense of the sugar to be fermented. Neuberg and Farber have assumed that if the production of this acid is bound up with the decomposition of the sugar, the influence of the addition of alkaline substances on the fermentation is analogous to the removal of a reaction product in a double decomposition.

As the reaction is biological the concentration of the hydroxy ion must be controlled carefully and only such alkaline reagents used as cause the transformation of hexoses into methylglyoxal, viz., potassium and sodium carbonates, potassium triphosphate, potassium and sodium sulphites and potassium metaborate.

To exclude the influence of the living cells, fermentation was carried on in alkaline media containing macerated dry yeast to which was added either cane sugar or glucose, after earlier experiments had indicated the insensitiveness of zymase and invertase to alkalis.

Observations

Fermentation mixtures containing 5% sugar, to which were added 1/10 of their volume of an aqueous solution of alkaline reagents and 10% toluol, showed the following phenomena:

1. Complete fermentation takes place when the mixture contains 0.1 to 0.2 part of carbonates, borates or triphosphates.
2. The sulphites must be present to the extent 0.02 part to accomplish the same result.
3. The addition of large quantities of alkalis is permissible only after the fermentation has once started.
4. No precipitates are formed in the fermented mixtures by the addition of the alkaline substances, even when they are added in such concentrations as would ordinarily give precipitates in unfermented mixtures.
5. If the allowable limit of the concentration of alkaline substances is exceeded, ammonium magnesium phosphate and tricalcic phosphate are precipitated.

The hindrance to fermentation which thereby results is not due to removal of the phosphate ion or to prevention of the formation of hexose di-phosphoric acid, as neither the addition of soluble phosphates or of pure hexose di-phosphoric acid will cause its resumption. Phosphoric or lactic acid, however, will have a different effect.

Influence of Alkaline Reagents

Alkaline reagents retard fermentation, the action being directly dependent on the concentration of the hydroxyl ion; also there is the influence of alkalis on the reaction which occurs before the evolution of carbon dioxide. This stage in the decomposition of sugar once entered upon suffers no harm from the introduction of large quantities of alkalis which ordinarily are detrimental.

The quantity of carbon dioxide evolved is a direct measure of the influence of alkalis on the fermentation process. Yeast working in an alkaline medium produces less alcohol, more aldehyde and considerably more glycerin, and yields also a new fermentation product, viz., trimethylene glycol.

*Der Seifenfabrikant, 1920, 161-13, 178-181.

†Neuberg and Farber, *Biochem. Zeit.*, 75, 238; Neuberg and Reinhardt, *Biochem. Zeit.*, 89365; ditto, *Biochem. Zeit.*, 92234.

Influence of Neutral Sulphites

Neuberg and Farber discovered unexpectedly in their researches that in contrast with the action of free sulphurous acid and the acid sulphites, the neutral sulphites have no deleterious effect, even when present in high concentrations. Neuberg and Reinfurth further developed this discovery and devised a method of obtaining large yields of aldehyde and fixed aldehyde formation as a definite intermediate step in the fermentation process.

Pyroracemic Acid

By the decomposition of pyroracemic acid into carbon dioxide and acetaldehyde, alcohol was obtained for the first time by the fermentation of a non-sugar. Immediately followed the hypothesis, viz., that pyroracemic acid and acetaldehyde are intermediate products in the decomposition of sugar, which is the fundamental concept of the modern theory of alcoholic fermentation.

Just as the alcoholic fermentation of sugar is due to the action of zymase, so pyroracemic acid may be fermented by the enzyme carboxylase. The attribute of a decomposition product, viz., that it is synthesized more easily than the more complex parent compound, applies to pyroracemic acid in its relation to sugar; furthermore carboxylase is always associated with zymase. Carboxylase is found not only in living yeast, but in all yeast preparations, in mycoderms, seeds and fruits.

Zymase and carboxylase are allied closely in their respective actions and their determining conditions. The exceptional non-poisonous qualities of pyroracemic acid also are noteworthy, a property possessed only by malic, lactic and tartaric acids which play an essential part in the growth of yeast. Furthermore the fermentation of pyroracemic acid is very rapid, being more than 2,000 times as great as sugar, as would be expected from an intermediate decomposition product.

The discovery of pyroracemic acid fermentation clarifies our understanding of the production of carbon dioxide in sugar fermentation. Molecular structure of hexoses makes impossible the direct splitting-off of carbon dioxide. Only from a carboxylic acid can carbon dioxide be so easily liberated as in alcoholic fermentation, without the aid of oxygen.

Aldehyde Stage of Fermentation

The second stage of fermentation yields acetaldehyde which indicates the relationship of sugar to the ethyl group of ethyl alcohol, which is not apparent from an examination of the sugar molecule.

The fermentation then comprises two stages, viz., oxidation of sugar by means of zymase to pyroracemic acid, and oxidation of the latter by means of carboxylase to acetaldehyde.

Neuberg and Reinfurth by the use of neutral sulphites succeeded in isolating the intermediate product in alcoholic fermentation. In the presence of neutral sulphites and with the fermenting medium protected by a supernatant layer of paraffin oil, the fermentation is anaerobic. Reduction of aldehyde to alcohol thus is prevented. The aldehyde exists in the medium as an addition compound of sodium bisulphite, on which fact is based the explanation of the possibility of its accumulation in large quantities without destroying the potency of the ferment.

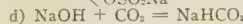
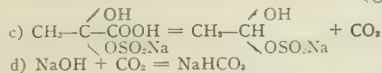
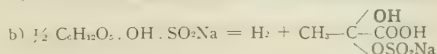
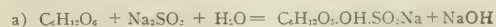
Conditions of Sulphite Fermentation

According to Kerp, when grape sugar is used, an addition product of glucose with sodium sulphite is formed first, which owing to its instability is resolved almost immediately into other acid sulphite addition products, e. g., those with acetaldehyde. According to Farnsteiner the instability of combinations of sodium acid sulphite with fructose in sodium acid sulphite solutions is still greater.

When neutral sulphite is used, a reaction by-product is sodium hydrate which stabilizes the complex addition product, which is of particular value in the case of loose addition compounds of sodium sulphite with cane sugar. As fermentation proceeds the acetaldehyde formed inhibits the deleterious action of sulphurous acid, so that the continuous decomposition of the sugar-sulphite compound proceeds of its own accord.

Tiemann has shown that presence of sodium acid carbonate aids the formation of these aldehyde addition compounds. This salt is produced automatically in the fermentation, as both sodium hydrate and carbon dioxide are formed therein as by-products of the reactions of the process, and may be detected by simple analysis.

The chemical reactions of the process at this stage are shown by the following equations:



Addition of sodium sulphite increases the yield of acetaldehyde, but the increase, however, is limited, notwithstanding its relatively slight effect on the ferment, by the retardation of fermentation. This limit is important, as only when the addition of sulphite is kept within it can fermentation be stopped at the acetaldehyde stage and reduction of the aldehyde to ethyl hydrate prevented. Under these conditions conversion of acetaldehyde to acetic acid, which is affected readily by saccharomycetic fermentation, is almost entirely absent.

On the other hand lactic acid is formed, a part of the sugar finally being resolved into this acid, which is due more to the presence of lactic acid ferments in the yeast which are active in alkaline media, than because of auxiliary reactions.

Sugars Available for Use

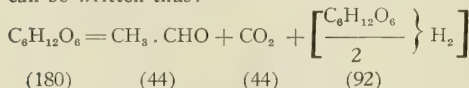
No important effect on these results arises from the kind of sugar used. Grape and fruit sugar give the same yield of acetaldehyde.

Cane sugar may be used instead of the monosaccharides. Invertase, as well as zymase and carboxylase, is active in strong alkaline media, although its action is rather disturbed by sulphites. The yield of aldehyde, as before, is dependent on the proportion of sulphite present. The amount of yeast used, however, does not affect the yield. In the studies summarized here top yeast was used because of its great resistive power (cultures M and XII, Institute for Garungsgewerbe, Berlin).

When fermentation is stopped artificially at the acetaldehyde stage the factors which ordinarily effect reduction of acetaldehyde to ethyl hydrate must manifest themselves otherwise. Hydrogen is

not evolved; neither is the sulphite, or carbon dioxide which results from oxidation, reduced.

Reduction must occur before the decomposition of the three-carbon chain (acetaldehyde) and the formation of ethyl hydrate and carbon dioxide, respectively two and one carbon chain compounds. The hydrogen must be kept from reacting with acetaldehyde, and must be made to react with the raw material, sugar. The fermentation equation then can be written thus:



Under these conditions one molecule of hexose produces one molecule of acetaldehyde, or a yield of 24.44 per cent. A yield of 17.95 per cent actually was obtained, or 73.45 per cent of the theoretical. Heretofore the fermentation ratio has been one molecule of sugar to two molecules of alcohol; now we have one molecule of sugar to one of acetaldehyde.

Reduction of the yield from the theoretical is due to the following reasons:

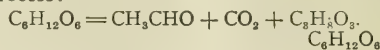
1. Physiological effect of the sulphites on the yeast organism;
2. Loss in sugar due to the formation of lactic acid and the starting of the fermentation reaction before the addition of the sulphite; and
3. Loss in sugar which is consumed in the alimentation of the yeast, which loss can be large when the yeast is placed in unfavorable media. Sugar consumed by yeast does not produce aldehyde.

Glycerin Stage of Fermentation

The ratio of acetaldehyde and glycerin is 1:1. Each molecule of acetaldehyde obtained as an end-product corresponds to the production of one molecule of glycerin. The two atoms of hydrogen lib-

erated from the hexose-sulphite compound, and which, in the ordinary fermentation of sugar, reduce aldehyde to alcohol, now combine with half a molecule of sugar to form glycerin.

Experiment demonstrates the truth of this hypothesis. Acetaldehyde obtained by the fermentation of pyroracemic acid was fixed as an addition compound of sodium sulphite. This compound in contrast with free acetaldehyde is unaffected by biological agents. Accordingly, in the fermentation of sugar, the final reaction in the process is prevented from taking place and as a result a disturbance in the regular oxidation and reduction reactions naturally occurs. In the course of the fermentation, as oxidation is taking place, and as an oxidation product acetaldehyde is being formed, the corresponding reduction product also must be created. This reduction product must be a derivative of sugar, as neither can free hydrogen be evolved, nor can the hydrogen reduce the acetaldehyde in combination with sodium sulphites. The following reaction, then, represents the fermentation process:



It is at once seen that the formula $\frac{\text{C}_6\text{H}_8\text{O}_3}{2} \text{H}_2$

is none other than glycerin, $\text{C}_3\text{H}_8\text{O}_3$. Based upon the respective molecular weights of acetaldehyde and glycerin, the quantity of glycerin formed theoretically is about twice as great as that of acetaldehyde. Practically only about half of the sugar, more exactly 51.11 per cent., can be converted into glycerin under the most favorable conditions. Neuberg and Reinfurth obtained 35.06 per cent, which is about 70 per cent. of the maximum quantity theoretically possible.

Ordinary fermentation of sugar with yeast yields 2.5 to 3.6 per cent. glycerin, being about one-twelfth that obtained by the sulphite process.

Personal Items

Henry Wigglesworth, director of development, General Chemical Co., sailed on Sept. 2, for Europe.

* * *

H. F. Knobloch, 50 East 32d street, New York, has been appointed New York representative of Texas Gulf Sulphur Company.

* * *

Frank Russell, formerly assistant general sales manager, American Synamid Co., is now associated with Eugene Suter & Co., 120 Broadway, New York.

* * *

The Standard Oil Company refinery at Baltimore, Md., will be increased from 6,000 to 26,000 barrels daily capacity requiring the expenditure for buildings and equipment of \$7,000,000.

* * *

The annual convention and exhibition of the American Steel Treating Society, in conjunction with the Steel Treating Research Society, will be held at Philadelphia, Pa., in the Commercial Museum building, September 14-18.

Dr. W. D. Bancroft, professor of physical chemistry, Cornell University, Ithaca, N. Y., has been engaged by the Norton Co., Worcester, Mass., grinding tools, etc., in consulting capacity in connection with its research laboratories.

* * *

James C. Stewart, of James Stewart & Co., 30 Church street, New York, has returned from abroad with the \$11,000,000 contract from the French Government for the construction of a 154-mile 10-inch pipe line for the transport of fuel oil from Havre to Paris. The contract provides one year for completion with a premium of \$250,000 if done within ten months which, Mr. Stewart says, his company intends to earn.

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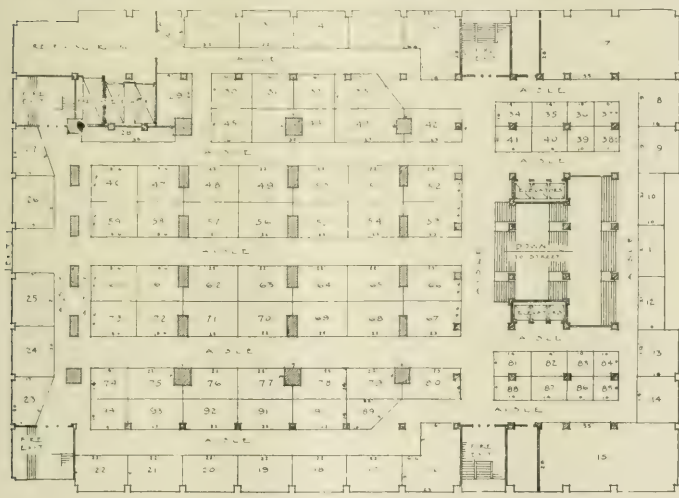
Robert F. Whitehead, since 1916 first assistant commissioner of patents, has been appointed commissioner to succeed James T. Newton, who resigned to take charge of the American business of a British firm of patent attorneys. Mr. Whitehead entered the patent service in 1902 as an examiner.

Exhibitors at the Sixth National Exposition of the Chemical Industries, Sept. 20-25, Grand Central Palace, New York, with Character of Industry and Representatives

Classified Alphabetically by Floors. First Floor—Exhibits 1-94 Inclusive

- 77-78—Abbe Engineering Co., 224 Bway, N. Y. Grinding and pulverizing machinery. H. K. Kleinfelt.
 77-86—Abbe, Paul O., Inc., 30 Broad St., N. Y. Grinding and pulverizing machinery. Henry Sellman; John Buckley.
 90—American Cynamid Co., 511 5th Ave., N. Y. Nitrogen fixation. Models, raw materials and products. E. J. Franke; J. P. Hubbell.
 6—Anasconda Copper Mining Co., 42 Bway, N. Y. Ores, precious metals, lead, copper, zinc, white lead. S. Skowronski.
 63—Baker, Jos., Sons & Perkins Co., Inc., White Plains, N. Y. Werner & Pfleiderer, mixing machinery. A. J. Vollrath; J. C. Caley; S. D. Grigley; E. Ziegler.
 82—Barger Asphalt Paving Co., Phila., Pa. Native lake asphalts and products.
 18-19—Barrett Co., The, 17 Battery Pl., N. Y. Coal tar chemicals. H. G. Sidebottom.
 77—Beach-Russ Co., 224 Bway, N. Y. Vacuum pumps, pressure blowers, gas boosters, acid pumps. C. A. Beach; H. C. Russ.
 13—Bethlehem Foundry & Machine Co., Bethlehem, Pa.
 84—Bristol Co., The, Waterbury, Conn. Recording instruments for pressure, temp., electricity, time, motion, etc. H. L. Griggs.
 41—Brown Instrument Co., Phila., Pa. Indicating and recording instruments for heat, pressure, vacuum, speed, time and operation. J. P. Goheen; G. W. Keller; J. D. Andrews; M. A. Leister; Geo. W. Goodman; R. B. McCafferty; C. D. Porterfield; O. W. Stowe.

- 58—Eimer & Amend, N. Y. City. Scientific apparatus, laboratory equipment, etc. C. G. Amend; Walter R. Eimer; F. W. Schulenberg; Theodore Taltz; L. Banner.
 92—Elyria Enamelled Products Co., Elyria, Ohio.
 37-38—Everlasting Valve Co., 2 Rector St., N. Y.
 60—Foote Mineral Co., Phila., Pa.
 3—General Bakelite Co., 2 Rector St., N. Y. Bakelite. Raw materials and applications. Messrs. Hilton, Swan, Gordon, May Rossi.
 17-18—General Chemical Co., 25 Broad St., N. Y. Mechanical roasting furnace. Mr. Keating.
 5—General Electric Co., Schenectady, N. Y. Electro chemical developments of the General Electric Co. laboratory. L. W. Shugg.
 54—Georgia Lead Works, Atlanta, Ga.
 32—Glen Falls Machine Works. 30 in. sulphur burner in operation. Harold D. Wells; Fred S. Chaffin.
 47—Goulds Mfg. Co., Seneca Falls, N. Y.
 58—Groch Centrifugal Flotation, Ltd., Calcutta, Ont.
 88—Gründler Patent Crusher & Pulv. Co., St. Louis, Mo.
 60—Hardinge Co., 120 Bway, N. Y. Conical ball and pebble mills for crushing, grinding, pulverizing. James G. Parmelee.
 10-11—Hooker Electro Chemical Co., N. Y. City. Chemicals; chlorine products. W. H. Chamberlain; B. K. Hotchkiss.
 54—Hoyt Metal Co., St. Louis, Mo.



First Floor Exhibit Booths.

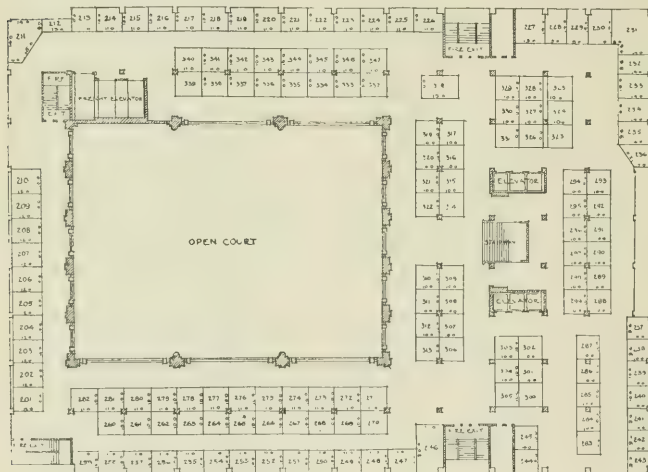
- 23-27—Buffalo Foundry & Machine Co., Buffalo, N. Y. Vacuum dryers, evaporators, chemical equipment, sugar machinery. E. G. Rippel.
 70—Calco Chemical Co., Bound Brook, N. J. Dyes and intermediates. Messrs. Sampson, Sumner, Klein, Bosworth, Akerman, Paradises and Merry.
 56—Carborundum Co., The, Niagara Falls, N. Y. Carborundum abrasives and refractories. Aloxite, Silicon. Otis Hutchins; S. C. Linbarger; Dr. L. M. Hartman; C. E. Hawke; W. L. Meek.
 1-2—Carrier Engineering Co., 39 Cortlandt St., N. Y. Humidifying equipment; high temp. Harrison heater. J. E. Bolling; B. C. Borden.
 12—Celluloid Zapon Co., 200 5th Ave., N. Y. Lacquers. B. O. Clausen; T. A. Brown.
 54—Chadwick-Boston Lead Co., Boston, Mass.
 61—Detroit Range Boiler & Steel Co., Detroit, Mich. Bilge barrels and drums; agitator equipment. W. B. Goddard; C. C. Choate; H. Ross Mack.
 15—Devine, J. P. & Co., Buffalo, N. Y. Vacuum and chamber dryers, vacuum pumps, general chemical equipment. J. P. Devine; L. W. Graves; H. C. Mills; George Galloway.
 51-52—Dorr Co., The, 101 Park Ave., N. Y.
 78—Dow Chemical Co., Midland, Mich. Heavy chemicals, pharmaceuticals, dyes, intermediates, insecticides. Messrs. Camp, Ashworth, Doan, Dorland.
 7-8—Du Pont, E. I. de Nemours & Co., Wilmington, Del.
 4—Duriron Co., The, Dayton, Ohio. Chemical apparatus—acid proof. F. D. Schenck; W. E. Hall; J. R. Fitman; J. Dart, Jr.; Oystein Jacobson; R. H. B. Elkins.

- 44—Huff Electrostatic Separator Co., Box 65, Arlington, Mass. Mineral concentration by electrostatic separator. H. B. Johnson; Wm. E. McKee.
 44—International Carbon Products Co., 230 W. 13th St., N. Y. Graphite and products. H. B. Johnson; C. D. Burrage, Jr.; J. F. Short.
 55—Leeds & Northrup Co., 4901 Stanton Ave., Phila., Pa. Electrical measuring instruments for chemical, metallurgical and shop practice. Paul E. Klopsteg; J. M. Stim; R. D. Milner; A. M. Redding; G. W. Tall.
 87—Mead & Co., Detroit, Mich. Grinding and pulverizing mills. Paul O. Abbe, Inc., 30 Broad St., N. Y.
 89—Merck & Co., 45 Park Place, N. Y. Pharmaceutical chemicals. Blue Label reagents.
 50—Mine & Smelter Supply Co., 42 Broadway, N. Y.
 75—Mott, J. L., Iron Works, 118 5th Ave., N. Y. City. Enamelled cast iron chemical apparatus. J. J. Blackmore; T. H. Blackmore; R. H. Horne.
 91—Nash Engineering Co., So. Norwalk, Conn.
 20-22—National Aniline & Chemical Co., 2E Burlington Slip, N. Y. City. Dyestuffs. E. A. Johnson; C. Zechendorf; F. D. Seales; E. Guiterman; E. W. Bowman; A. E. Wood; E. Gainey; C. M. Patterson; P. J. Herrmann; P. S. Crowell; A. D. Guion.
 28—National Gum & Mica Co., 11th Ave. and 9th St., N. Y. City.
 8-9—N. J. Zinc Co., 160 Front St., N. Y. Zinc, zinc compounds and heavy chemicals. W. Homer Hendricks; S. T. Ballinger.
 62—Newport Chemical Works, Inc., Passaic, N. J. Dyestuffs. Giles Schmalenberger; C. J. Rupp; Jos. H. Lange; E. W. Low; Dr. E. H. Killheffer.
 34—Norton Co., Worcester, Mass. Aluminum and crystalline refractories, laboratory ware and abrasives. H. R. Savage; R. Kirkpatrick.
 93—Palo Co., The, 90 Maiden Lane, N. Y.
 33—Pennsylvania Salt Mfg. Co., Widener Bldg., Phila., Pa. Heavy chemicals. Wedge Mechanical Furnace. Messrs. Hutchinson and James.
 73—Pfauder Co., The, Rochester, N. Y. Glass-lined steel chemical equipment. W. E. Foster; R. B. Kimer; T. E. Colvin; P. Barnes; J. A. Cowles; R. L. Jacobs; T. D. Wilson.
 80—Precision Instrument Co., 21 Halsey St., Newark, N. J. Boiler room and gas plant specialties. Messrs. Vorree, Rack and Tighman.
 77-78—Provost Engineering Co., 220 Bway, N. Y. Mixing machinery. O. T. Beach, Jr.
 49—Raymond Bros. Impact Pulverizer Co., 1319 N. Branch St., Chicago. Automatic pulverizers for fine grinding. C. M. Lauritzen. F. I. Raymond; Joe Crites; S. B. Kanowitz.
 54—Raymond Lead Works, Chicago, Ill.
 Robertson Lead Works, James, Baltimore, Md.
 4—Research Corporation, 31 W. 43d St., N. Y. Cottrell Electrical Precipitation Process. N. W. Solter.
 83—Ruggles-Cole Engineering Co., 50 Church St., N. Y. Dryers.
 65—Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
 16—Solvay Process Co., Syracuse, N. Y. Alkalies. E. C. Scott; James Cooper; W. H. C. Grimes; C. A. Cole; M. H. Kramer.
 16—Smet-Solvay Co., Syracuse, N. Y. Coal tar products and derivatives. E. C. Scott.

- 84—Sharples Specialty Co., 501 5th Ave., N. Y.
 46—Sherwin-Williams Co., Cleveland, Ohio.
 39—Sido Co. of America, 37-39 Murray St., N. Y. Fused silica ware. F. H. Ruhe; W. Fensterer; G. H. Mueller.
 72—Sowers Mfg. Co., 1300 Niagara St., Buffalo, N. Y. Industrial Chemical Apparatus. R. C. Bogges.
 85-86—Stokes Machine Co., F. J. Phila, Pa. Chemical and pharmaceutical machinery. C. H. Bailey; C. F. Coleman.
 30-31—Sturtevant Mill Co., Boston, Mass. Chemical Engineering Equipment. S. H. Sturtevant; H. A. Tomlinson; W. T. Doyle.
 64—Swenson Evaporator Co., 945 Monmouth Bldg., Chicago. Evaporators. F. M. De Beers; P. B. Sadtler; G. Gordon Urquhart; P. H. Appell.
 57—Thermal Syndicate, Ltd., 50 E 41st St., N. Y. Fused silica ware and equipment. W. E. Streivig; S. L. Tyler; W. W. Winship.
 40—Thwing Instrument Co., 3339 Lancaster Ave., Phila, Pa. Temperature recording and indicating apparatus, paper-testing instruments. Dr. C. B. Thwing; E. J. Albert; H. K. Walton; J. H. Torrey; A. S. Hall.
 68-69—Tolhurst Machine Works, Troy, N. Y. Centrifugal and hydro-extractors. W. C. Dutton; R. H. Cheney; J. S. Gage; T. M. Stuart; B. M. Pilhasky; T. A. Bryson.
 45—Uehling Instrument Co., 71 Bway., N. Y. Fuel-saving equipment. F. F. Uehling; C. J. Schmidt; C. C. Phelps; W. J. Reilly.
 53—United Filters Corporation, 65 Bway., N. Y. Filter presses. H. J. Runyon, Jr.
 54—United Lead Co., New York City.
 4—United Lead Tube & Valve Co., New York City.
 6—United Metals Selling Co., 42 B'way., agts.
 —Raritan Copper Works, Anaconda Copper Mining Co.
 76—United Cast Iron Pipe and Foundry Co., Burlington, N. J. Chemical engineering equipment. H. A. Hoffer; J. D. Capron; C. D. Donaldson.
 46—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Electrical equipment for the chemical industries. C. B. Gibson; G. H. Jaspert.
 12—Zapon Leather Co., 200 5th Ave., N. Y. Artificial Leather. Gustav Gurska; Weyland Pfeiffer; W. E. Chapman.
 1—Zaremba Company, Buffalo, N. Y. Evaporators. H. E. Jacoby; W. H. Eggert.

Second Floor—Exhibits 201 to 347

- 332—Alberene Stone Co., 323 East 23rd St., N. Y.
 231—Alcohol Products Co., 30 Church St., N. Y.
 241—Allis-Chalmers Mfg. Co., Milwaukee, Wis. Dust collector. M. I. Dorian.
 201-205—American Aniline Products Co., 80 5th Ave., N. Y. Dye-stuffs and Synthetics. B. R. & J. L. Armour; Messrs. Collins (Dist. Mgr.) Nobbe, Fischer, Gould, Weckman, James, Chase, O'Hara, Hennessy, Whyte, Gregor, Rocelos (Dist. Mgr.), Schleicher, Fenton Gossen, Mehnen, Bennefeld (Dist. Mgr.), Giroward, Tentress and McDermott.
 319-320—American Chemical & Mfg. Co., Norfolk, Va. Paints, lacquers and driers.
 210-216—American Chemical & Sugar Machinery Co., Phila, Pa. Chemical engineering equipment. Messrs. Lawrence, Dungenison and Comey.



Second (Mezzanine) Floor Exhibit Booths.

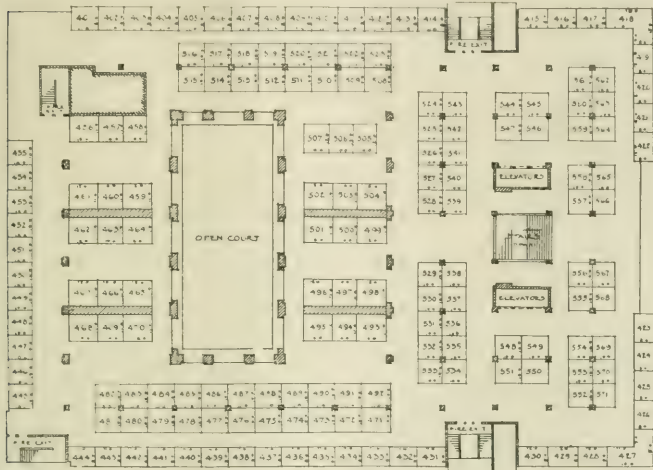
- 308-311—Chris Co., Antoine, 18-20 Platt St., N. Y. Essential oils, synthetic aromatics and resins.
 256-257—Cleveland Cliffs Iron Co., Cleveland, Ohio. Wood chemicals, etc. Chas. B. Hall; Austin Farrell; E. J. Hudson.
 291—Clinchfield Products Corp., 120 B'way., N. Y. Feldspar. Chas. Ingram; Leo L. Hunt.
 317—Commercial Solvents Corp., 165 B'way., N. Y. Chemical solvents and products. H. E. Hall; C. L. Gabriel; T. F. Carty.
 338-341—Corning Glass Works, Inc., 501 5th Ave., N. Y.
 252—Drackett & Sons Co., The P. W. Cinti, Ohio. Industrial chemicals. P. W. Drackett, Jr.; B. S. Hall; Hugo Juhlin.
 217-220—Eastman Kodak Co., Rochester, N. Y.
 231—Edg Bros. Co., 30 Church St., N. Y.
 321-322—Electro Bleaching Gas Co., 18 E. 41st St., N. Y.
 271-278—Electrolytic Zinc Co., Inc., 62 B'way., N. Y.
 344—Empire Laboratory Supply Co., 218 E. 37th St., N. Y.
 241-243—Fleisher & Co., W. L., 31 Union Sq., N. Y. Air conditioning and spray drying. W. L. Fleisher; A. W. Lisauer; D. L. Connelly.
 346-347—Foxboro Co., Inc., Foxboro, Mass. Indicating and recording instruments for pressure, vacuum, time, temperature, liquids and gases. W. H. Patrick; E. P. Grout.
 284-285—Garrigue & Co., Wm., 154 Nassau St., N. Y. Oil fats and products. J. W. Bodman; W. F. Sanger; O. H. Wurster; T. M. Godfrey.
 222-224—General Ceramics Co., 50 Church St., N. Y. Chemical stoneware and refractories. Messrs. Kingsbury, Whittaker, Beecher, Otto, Royer and Peters.
 251—General Filtration Co., Inc., Rochester, N. Y. Acid-proof filters. F. E. Leiby; Col. W. W. Robacher.
 227—General Fire Extinguisher Co., Providence, R. I.
 228-230—Gordon Dryer Corp., Providence, R. I. Drying machinery. Nathan Owitz; N. W. Parks; W. R. Murray.
 115-216—Greiner Co., Emil, 55 Fulton St., N. Y.
 250—Haynes Stellite Co., Kokomo, Ind.
 226—Herold China & Pottery Co., Golden, Colo.
 3'3-325—Hercules Powder Co., Wilmington, Del. Pyroxylin, naval stores, explosives.
 '96-297—Hoskins Mfg. Co., Grand Central Terminal, N. Y.
 3'6-331—Neighborly Knoxville, 422 S. Gey St., Knoxville, Tenn. Natural resources of the Knoxville Territory. Dr. W. G. Waldo; Prof. Harry Clark; Dr. Walter McIntyre; Wm. R. Pouder.
 312-313—Koppers Co., The, Pittsburgh, Pa. By-product coke and gas ovens. E. L. Crowe; C. R. Meissner.
 345—Lammers & Mann Co., Chicago. Rotary vacuum pumps. A. L. Eisenbeis; Donald Rosier; R. F. Lammert.
 283—Lungmott Co., The, Boston, Mass.
 260-261—Lunkenheimer Co., The, Cincinnati, Ohio. Engineering accessories. H. S. Whittier; R. S. Rowe; W. A. Reynolds; F. E. Hyatt; Phil Smith; J. E. Cooper; H. J. McCloghnan; Dr. Geo. K. Elliott.
 206-208—Merrill Co., The, 121 2d St., San Francisco, Cal. Merco Nordstrom valve.
 277-278—Metals Disintegrating Co., 62 Bway, N. Y. Powdered metals. C. F. Schatzberg.
 254-255—Multi-Metal Co., New York City. Wire cloth and filters. testing sieves. S. Stern; F. Stern; S. Pullman; L. Dressner.
 298-299—Newark Wire Cloth Co., Newark, N. J. Wire filter cloths and strainers. A. A. Campbell; E. J. Nichols.
 314-315—Niagara Alkali Co., 18 E. 41st St., N. Y.
 265—Niagara Electro Chemical Co., Niagara Falls, N. Y. Chemicals. Herbert Gillis.
 207—Nitrogen Corporation, Providence, R. I.
 269-270—Oliver Continuous Filter Co., 31 E. 42d St., N. Y.
 294-295—Organic Salt & Acid Co., Inc., 81 Fulton St., N. Y.
 264—Perth Amboy Chemical Works, Perth Amboy, N. J.
 289-290—Philadelphia Drying Machinery Co., Philadelphia, Pa.
 233-36—Proctor & Schwartz, Inc., Philadelphia, Pa.
 244-245—American Hard Rubber Co., 11 Mercer St., N. Y. Hard rubber pumps, piping and specialties. A. M. Ackerman; D. Wilkins.
 279-280—American Metal Co., Ltd., 61 B'way., N. Y. Ores, minerals, heavy chemicals. H. M. Burkey; E. K. Judd; R. C. Latz; Miss A. M. Stout.
 342—American Rolling Mill Co., 51 Church St., N. Y.
 273-274—Angel & Co., Inc., H. Reeve, 7-11 Spruce St., N. Y. Filtering papers and filtering materials, laboratory supplies. B. S. Proper; F. L. Harrocks.
 301-304—Aniline Dyes & Chemicals, Inc., 134 Cedar St., N. Y. Dye-stuffs. W. H. Fieldhouse; C. A. Mace; J. B. Jones; F. C. Wittig; R. Ely.
 267-268—Anti-Hydro Water Proofing Co., 299 B'way., N. Y.
 287—Apex Chemical Co., 61 Park Row, N. Y.
 246-247—Arnold Hoffman & Co., 61 B'way., N. Y.
 334-337—Bachmeier & Co., 438 W. 37th St., N. Y. Aniline dyes. G. M. Lord; Wm. Bauer; Henry Gettler.
 333—Baker Chemical Co., J. T., Phillipsburg, N. J. Chemical Reagents.
 253—Buckman & Pritchard, Inc., 94 Fulton St., N. Y. Refractories, electric porcelain, zirconium silicate. Geo. A. Pritchard; H. H. Buckman.
 281-282—Chemical Co. of America, 46 Murray St., N. Y. Dye-stuffs. Chas. Kendall; Dr. S. Isler; F. R. Lehman; Peter Christ; M. Sachs; J. E. Graham; Robt. A. Steele.

- 288—Pyroelectric Instrument Co., Trenton, N. J.
 289—Rohrbaugh Co., The, 36 Carroll Ave., Jersey City, N. J.
 284-266—Rossler & Hasselcher Chemical Co., 505 6th Ave., N. Y.
 292-293—Rollin Chemical Corporation, 130 B'way, N. Y.
 316—Scott & Co., Ernest, Fall River, Mass.
 271-272—Sydell Mfg. Co., The, Jersey City, N. J.
 211-212—Stein Hall & Co., Inc., 61 B'way, N. Y.
 275-276—Tagliabue Mfg. Co., The, Brooklyn, N. Y.
 248-249—Taylor Instrument Companies, Rochester, N. Y.
 232-233—Thermo Electric Instrument Co., Newark, N. J.

- 262-263—Titanium Alloy Mfg. Co., Niagara Falls, N. Y.
 237-240—Union Steam Pump Co., Erie, Pa.
 300—U. S. Industrial Alcohol Co., 27 William St., N. Y.
 305—U. S. Industrial Chemical Co., 40 William St., N. Y.
 343—Vitreous Enameling Co., Cleveland, Ohio.
 225—Wallace & Tiernan Co., Inc., 4 B'way, N. Y. Chemical control apparatus. M. E. Tiernan, Wm. J. O'Connor, L. H. Guebel, R. V. Donnelly, H. D. Thompson.
 344-335—Whitall Tatum Co., 46 Barclay St., N. Y.

Third Floor—Exhibits 401 to 571

- 554—Ainsworth & Sons, Wm., Denver, Colo. Assay and analytical balances. Robt. G. Ainsworth.
 482-483—Ajax Electrothermic Corp., Trenton, N. J. Ajax Metal Co., Philadelphia, Pa. Electric furnaces. Dr. Northrup; Dudley Wilcox; H. F. Porter; G. H. Clamer.
 401-402—Allan Electrolytic Cell Corp., Portland, Me. Allen-Moore cell. Howard D. Marsh; Kent R. Fox.
 438—American Kron Scale Co., 430 E 53d St., N. Y.
 404—American Metal Products Co., Milwaukee, Wis. Acid-resisting Ampeo metal. C. J. Zaiser; R. W. Alger.
 420—American Water Softener Co., Philadelphia, Pa. Water softener and filter. M. W. T. Kenner; G. M. Graybill; R. W. Conard.
 510—Arkell Safety Bag Co., 120 B'way, N. Y. Elastic paper linings for containers. P. J. Morales.



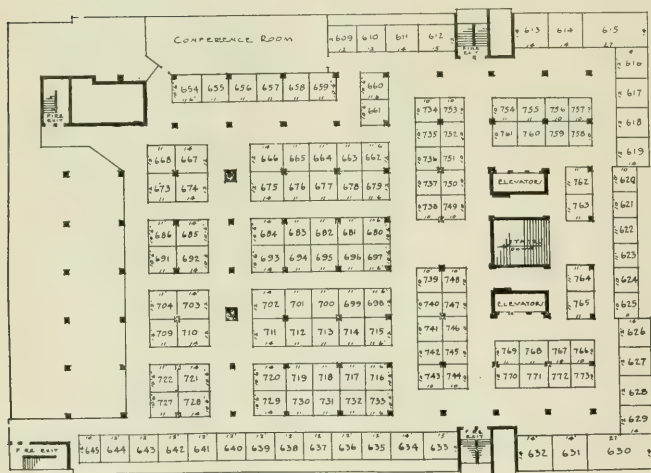
Third Floor Exhibit Booths.

- 494—Aterite Co., Inc., New York, N. Y. Aterite valves, pipes, fittings and structural material. E. J. Jarvis.
 414—Atlas Electric Devices Co., Chicago, Ill. Color Fade-ometer. C. W. Jameson; H. G. Weighman.
 559-561—Bailey Meter Co., Cleveland, Ohio. Meters for water, steam, gas, chemicals, etc. Messrs. Bailey, Little, Hammond, Dmytrov and Repa.
 306-307—Bausch & Lomb Optical Co., Rochester, N. Y. Microscopes, optical instruments.
 537-538—Becker, Inc., Christian, 92 Reade St., N. Y. Analytical and chainomatic balances, torsion scales. Messrs. Millroy, Ferdon, Taylor, Hess and Metz.
 506—Breckley Perforating Co., Garwood, N. J. Perforated metal shapes; electrically welded steel. Allan A. Price.
 444—Blackmer Rotary Pump Co., Detroit, Mich.
 406—Blakiston's Son & Co., P., Phila., Pa. Books for chemists and physicists. E. B. Barnes.
 462-463—Booth Electric Furnace Co., Chicago, Ill. Electric rotating furnaces. C. H. Booth; E. F. Tweedy; F. W. Doran.
 442—California Alkali Co., Carlsbad, Calif.
 473—Canada: Dominion Water Power Branch. Natural resources of Canada.
 487—Canada, Iron & Steel Co. of, Gardenvale, P. A.
 491-492—Canada: Ontario Bureau of Mines, Toronto, Ont. Ontario minerals and metallurgical products. W. K. McNeill; W. R. Rogers.
 471—Canadian Electrode Co., Montreal, Que.
 489-490—Canadian Pacific Railway, Montreal, Que. Natural resources and transportation of Canada.
 496-498—Central Scientific Co., Chicago, Ill. Laboratory apparatus and supplies. Messrs. Redman, Louis and Carter.
 495—Chemical Age, 118 E. 28th St. McCready Publishing Co. Robert H. McCready; E. J. Mordaunt; C. W. Butterworth; Lloyd Lamborn.
 517—Chemical Equipment Co., Chicago, Ill.
 595—Chemical Equipment & Valve Co., Perth Amboy, N. J. Packingless pumps, valves, chemical machinery. A. B. Driscoll; F. A. Watter.

- 425—Clipper Belt Lacing Co., Grand Rapids, Mich. Lacing machines and hook lacing. W. F. Ryan.
 522—Consolidated Chemical Products Co., Alton, Ill.
 432—Contact Process Co., Buffalo, N. Y. Mineral acids and salt cake. Truman Smith; Dr. H. Von Rucker.
 429-430—Crane Co., Chicago, Ill. Valves and pipe fittings. M. L. Oswald; Wm. Smk; Wm. Whyte.
 536—Crane Packing Co., Chicago, Ill.
 531-3—De Laval Separator Co., 165 B'way, N. Y.
 529-530—Denver Engineering Works Co., Denver, Colo.
 479—Dermatological Research Laboratories, Phila., Pa.
 468-70—Detroit Electric Furnace Co., Detroit, Mich. Electric melting furnace. Messrs. Crosby, Rhoads, Kavanagh and St. John.
 548-549—Dings Magnetic Separator Co., Milwaukee, Wis. Magnetic separators. Messrs. Managold, Ackerman, Hirschberg and Randall.
 544-545—Draper Mfg. Co., Cleveland, Ohio. Steel barrels. H. W. Lees.
 569-571—Drying Systems, Inc., Chicago, Ill. Drying equipment. F. A. Lippert; E. E. Lippert; C. H. Currier.
 524-526—Eagle Pitcher Lead Co., Chicago, Ill. Lead products. Messrs. Gates, Brown, Gilson, Kelly and MacGregor.
 423-424—Economic Machinery Co., Worcester, Mass.
 434-435—Economy Engineering Co., Chicago, Ill. Portable elevators and tiring machines. W. B. Tordoff; T. A. Duffy; L. H. Liebel; Geo. B. Skinner.
 449-450—Electric Furnace Co., Alliance, Ohio.
 500—Engelhardt, Charles, 30 Church St., N. Y. Pyrometers, electric furnaces, impervite refractories and porcelains. C. W. Hubbard; E. S. Newcomb.
 467—Fansteel Products Co., South Chicago, Illinois.
 513—Florasynth Laboratories, Inc., Unionport, Bronx, N. Y. Aromatic chemicals for perfumery and flavoring. Messrs. Rosett, Senior and Katz.
 427—General Electric Co. (Lake Erie Chemical Works), Sela Park, Cleveland, Ohio.
 508-509—523—Glamorgan Pipe & Foundry Co., Lynchburg, Va. Chemical engineering equipment. C. H. Hinnant.
 451-452—Hamilton & Hansel, Inc., 13 Park Row, N. Y. Electric furnaces. H. A. De Fries; Paul Axel.
 490—Hanovia Chemical & Mfg. Co., Newark, N. J. Quartzware laboratory furnaces, pyrometers, violet-ray lamps.
 441—Hays Corp., Jos. W., 30 Church St., N. Y. CO. recorders, draft gages. Stephen H. Payne.
 493—Hunter Dry Kiln Co., Indianapolis, Ind. Dryers. O. M. Ragsdale; A. B. Stonex.
 567—Huyck & Sons, F. C., Albany, N. Y. Wool filter cloth. Dr. D. A. MacInnes; A. L. Wright; G. L. Gundel.
 476—Ideal Stencil Machines, Phila., Pa.
 565-566—Independent Chemical Co., 22 West St., N. Y.
 454-455—Industrial Electric Furnace Co., Chicago, Ill.
 456-458—International Nickel Co., 43 Exchange Pl., N. Y. Nickel and monel metal. Messrs. Wheeler, Dauchy and Waycott.
 440—Irving Iron Works Co., Long Island City, N. Y. Safety platforms and stairways. Messrs. Irving, Price, Lown, Madden, Moser and Schulz.
 428—Jewell Polar Co., Chicago, Ill. Laboratory and industrial water stills. A. C. Jewell; J. E. Bloeser; P. M. Marks.
 555-556—Kalfbeisch Corporation, 31 Union Sq., N. Y. Heavy chemicals. C. L. Hutzelman.
 405-406—Kenert Synthetic Products Co., Chicago, Ill.
 497—Kewanee Mfg. Co., Kewanee, Ill. Laboratory furniture.
 565—King Chemical Co., 12 West St., N. Y.
 484-486—Knight, Maurice A., East Akron, Ohio. Acid-proof chemical stoneware. Maurice A. Knight; Chas. Dennison; Sam'l J. Bari; N. D. Whipple.
 465—Lead Lined Iron Pipe Co., Wakefield, Mass. Galvanized lead-lined pipe, valves, fittings, etc. Dan'l H. Regan; Frank H. DuBois.
 520-521—Lindsay Light Co., Chicago, Ill.
 403—Liquid Carbon Co., Chicago, Ill.
 421-422—Magnetic Mfg. Co., Milwaukee, Wis. Magnetic separators for ore concentration. J. P. B. Bickel.
 433—Mann & Cook, 120 B'way, N. Y. Oils.
 525—Midland Chemical Co., Midland, Mich.
 550-551—Mid West Engine Co., Indianapolis, Ind.
 412—Monarch Mfg. Works, Inc., Phila., Pa.
 517—Monel Metal Products Co., Bayonne, N. Y.
 518—National Filter Cloth & Weaving Co., Brooklyn, N. Y.
 466—Obermayer Co., The S., Pittsburgh, Pa. Hott-Patch furnace

- cement. Messrs. Frohman, Cummings, Beckman and Hildebrand.
- 439—Oxygen Products Co., 30 Church St., N. Y.
- 515-516—Ozone Co. of America, Milwaukee, Wis. Equipment for water and air purification. Wm. J. Eberley; C. O. Riedel.
- 552-553—Parks-Cramer Co., Boston, Mass. Fluid heat transmission. Air conditioning. Messrs. Thompson, McKechnie, Francis and Bell, Jr.
- 442—Payne, Stephen H., 30 Church St., N. Y. Combustion efficiency appliances.
- 480-481—Permutit Co., The, 440 4th Ave., N. Y. Water softeners, filters and conditioners. Messrs. Smith, Eppel, Corin, Shedden; C. L. Boyd.
- 568—Perry & Webster, Inc., 31 Union Sq., N. Y. Industrial engineering service. Messrs. Perry, Webster and Boynton.
- 519—Peterson, Leonard & Co., Chicago, Ill. Laboratory furniture.
- 501—Philadelphia Quartz Co., Phila., Pa. Silicate of soda. Messrs. Carter, Quintard, Buxton, Moore and Brown.
- 474—Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
- 415-417—Pneumator Co., Inc., 15 Park Row, N. Y. Liquid measuring devices. H. S. Parks; Wm. Thomas.
- 541-543—Pratt Engineering & Machine Co., 125 E. 46th St., N. Y.
- 539-540—Quigley Furnace Specialties Co., 26 Cortlandt St., N. Y. Furnace design, materials, construction, operation and appliances.
- 464—Refinite Co., Omaha, Neb. Water softener. L. R. Whitcomb; C. M. Dunn; J. F. Greenfield.
- 512—Republic Flow Meter Co., Chicago, Ill. Steam, water, air and gas flow meters. Thos. Curran; Geo. Hendrickson.
- 441—Roto Co., The, Hartford, Conn. Mechanical cleaning devices for boilers, evaporators, condensers, etc. Messrs. Van Noetwijk, Kelley and Beer.
- 504—Sarco Co., 233 B'way, N. Y. Sarco steam traps, regulators, strainers, recorders, etc. E. J. Ritchie; G. W. Bergen.
- 502-503—Schaar & Co., Chicago, Ill. American-made laboratory apparatus. A. E. Schaar.
- 431—Schwartz Sectional System, Indianapolis, Ind. Laboratory filing cabinets. M. P. Schwartz.
- 496-498—Scientific Equipment Co., 70 5th Ave. Laboratory furniture and apparatus. Messrs. Redman, Carter, Campbell, Louis, Blodgett and Ress.
- 507—Seymour & Peck Co., Chicago, Ill. Containers for dry chemicals. C. B. Arnold.
- 471-472—Shawinigan Water & Power Co., Montreal, Que., and subsidiaries, viz., the Shawinigan Products Corp., 160 5th Ave., N. Y.; The Canada Carbide Co., Montreal, Que., and The Canadian Electro Products Co., Montreal, Que. Electrolytic chemicals. H. E. Mussett; V. G. Baetram; J. C. Fruit; Henry Barth.
- 534-535—Sparkes, John C., 42 Warren St., N. Y. Dyes.
- 566—Stauffer Chemical Co., Chaucery, N. Y.
- 565—Sterling Color Co., 122 West St., N. Y.
- 557-558—Stimpson Equipment Co., Salt Lake City, Utah. Mitchell electric vibrating screens. Messrs. Stimpson, Lane, Klein and Martin.
- 459-460—Sullivan Machinery Co., Chicago, Ill., 30 Church St., N. Y. Air lifts for water and acids. John Oliphant; L. R. Chadwick; L. E. Gilbert.
- 562-564—Sunbeam Chemical Co., Chicago, Ill.
- 475—Tabor Pump Co., Buffalo, N. Y.
- 527-528—Thomas Co., Arthur H., Philadelphia, Pa. Laboratory equipment and supplies.
- 418—Union Sulphur Co., 17 Battery Pl., N. Y. Sulphur. W. N. Wilkinson; W. M. P. Taylor.
- 461—U. S. Smelting Furnace Co., Belleville, Ill. Rotary furnaces for foundry and smelter. Messrs. Marsh, Jones, Langfelder.
- 436-437—Valley Iron Works, Williamsport, Pa. Autoclaves and sulphophators. Messrs. Senior, Mills and Jacobs.
- 417—D. Van Nostrand Co. Scientific and technical books. E. M. Crane; A. G. Heany.
- 566—Vulcan Detinning Co., Seward, N. J.
- 411—Whitlock Coil Pipe Co., Hartford, Conn.
- 497—Whitney Test Laboratories, Chicago, Ill.
- 413—Willson Goggles, Inc., Reading, Pa. Respirators, gas masks, goggles. Walter Siderling; F. M. Rockwell.
- 546-547—Worthington Pump & Machinery Co., 115 B'way, N. Y.

Fourth Floor—Exhibits 609 to 773



Fourth Floor Exhibit Booths.

- 660—American Dresser Tunnel Kilns, 171 Madison Ave., N. Y.
- 614-616—American Dyes Institute, 320 B'way, N. Y.
- 751—American La France Fire Engine Co., Elmira, N. Y. Safety devices, chemical engines, fire extinguishers. H. J. Lovell; J. W. Knoblock.
- 740—Armstrong Pulverizer Co., St. Louis, Mo. Pulverizing machinery. Paul S. Knittel.
- 715—American Steel & Wire Co., 30 Church St., N. Y.
- 759-759—Aniline Sales Corp., 480 W. B'way, N. Y.
- 764-765—Anthrakone Dye Products & Chemical Co., 1834 B'way, N. Y.
- 612—Armstrong Cork & Insulating Co., Pittsburgh, Pa. Heat insulation materials.
- 613—Atlantic Dyestuff Co., 88 Ames Bldg., Boston, Mass. Dyestuffs. Chas. H. Stone; G. R. Stoettner; Dr. H. M. Paine; H. R. Ullrich; C. C. Burt; Karl Ruger.
- 735—Avery Rock Salt Mining Co., New York City.
- 656—Chapman Engineering Co., Mt. Vernon, Ohio. Gas producer. Draught and pressure regulating and recording devices. W. B. Chapman; John M. Capron.
- Chapman-Stein Furnace Co.
- 737—Babbitt, B. T., 15 W. 34th St., N. Y.
- 610—Bacharach Industrial Instrument Co., Pittsburgh, Pa. Gas and air recorders. H. Bacharach; Herman H. Sticht; Fred J. Lauterbach.
- 732—Beaver Chemical Co., Damascus, Va. Sulphur blue and anthraquinone dyestuffs. J. B. Dunbar; G. M. Smyth; J. J. Crist.
- 738—Boyer Oil Co., Inc., 25 W. B'way, N. Y.
- Boyer Oil Mfg. Co., Indianapolis, Ind.
- 685-692—Brown Portable Conveying Machinery Co., Chicago, Ill. Conveying Machinery. O. H. Oertel.
- 675—Burrell Technical Supply Co., Pittsburgh, Pa. Gas analysis apparatus and laboratory equipment. G. H. Barrett; H. J. Segrave.
- 642—Chapman Valve Mfg. Co., 180 Lafayette St., N. Y.
- 610—Cleveland Instrument Co., Cleveland, Ohio. Indicating and recording pyrometers. Messrs. Sticht, Lauterbach, North & Rich.
- 719-720—Container Club, The, Chicago, Ill. Corrugated and solid fibre containers, sealing machines. G. R. Browder; W. S. Salt; J. W. Webb; J. D. Malcolmson.
- 984—Crescent Sales & Engineering Co., Detroit, Mich. Vacuum and pressure pumps. L. L. Beeken.
- 682—Davidson Co., M. T., 154 Nassau St., N. Y. Steam pumps. John Lowe; Wm. E. Brennan.
- 637-638—Davison Chemical Co., Baltimore, Md. Ores, heavy chemicals, silica. E. B. Miller; Dr. B. F. Lovelace; Dr. W. A. Patrick; W. D. Huntington; J. R. Wilson; A. E. Marshall.
- 624—Diamond State Fibre Co., Bridgeport, Pa. Vulcanized fibre and commodities. Chas. M. Bogert.
- 739-740—Dunning, Lueckel Engineering Co., 30 Church St., New York. American Ring pulverizer, Nelson filter press. Messrs. Dunning, Leuckel and Knittel.
- 631—East Jersey Pipe Corp., 50 Church St., N. Y.
- 752-753—Egyptian Lacquer Mfg. Co., 5 E. 40th St., N. Y. Lacquers, enamels, etc. Messrs. Soper, De Baun, Popper, Hayward, Henry and Schlott.
- 732-733—Exciolor Dyestuff & Chemical Co., 46 Vesey St., N. Y. Dyestuffs, sizing and finishing agents. Walter Reinecke; Chas. Frankel.
- 754-755—Falcon Dye & Chemical Co., New York City.
- 621—Foamite Firefoam Co., 200 5th Ave., N. Y. Fire protection service, extinguishers and systems. E. W. Ross; R. H. Austin; M. Hovey; S. J. Chamberlain.
- 609—Fuel Products Corp., 110 W. 40th St., N. Y. Coal distillation equipment.
- 716-717—Garrigues Co., Chas. F., 54 Wall St., N. Y.
- 742—General Briquetting Co., 25 Broad St., N. Y. Briquetted pulverized materials. A. L. Stillman; J. Spring; J. E. Stevens.
- 712-714—Geigy Co., Inc., 49 Barclay St., N. Y. Dyestuffs. Robt. Keller; Wm. F. Kip; Walter Saenger; J. R. Geigy; Wm. F. Zipse.
- 678-679—Glass Coating Co., Cleveland, Ohio.

- 711—Gottesman & Co., Inc., M., 18 E. 41st St., N. Y. Distribution of industrial chemicals. A. J. Sigel; G. A. Gardner; E. A. Pita.
- 772-773—Greeley Products Corp., 15 Park Row, N. Y. Edible and industrial fats and oils, pine products and chemicals. H. A. Carman; H. S. Kenyon; W. R. Boin; B. D. McCampbell.
- 694—Guernseyware Co., Cambridge, Mass., B. D. McCampbell.
- 703—Hauser-Stander Tank Co., Cinti., Ohio. Wood tanks. S. Hauser, Jr.; J. B. Dorlan.
- 750—Haywood & Co., C. F., 250 W. 54th St., N. Y.
- 650-681; 696-697; 71—Hercules Engineering Corp., 501 5th Ave., N. Y.
- 701—Hoyt Laboratories, Inc., 437 Barretto St., N. Y.
- 636—Heydon Chemical Co. of America, 135 William St., N. Y.
- 786—Hydrocarbon Chemical Co., Lancaster, Pa.
- 641—Imperial Dyewood Corp., 1328 B'way, N. Y.
- 745-746—Innis, Speiden & Co., Inc., 46 Cliff St., N. Y.
- 722—International Coöperage Co., Inc., Niagara Falls, N. Y.
- 735—International Salt Co., 2 Rector St., N. Y. Salt. H. J. Osborn.
- 635—Joplin Whiting Co., Joplin, Mo. Whiting. B. D. Reynolds; S. A. Toner.
- 617-619—Klipstein & Co., A., 654 Greenwich St., N. Y.
- 667-674—Lakewood Engineering Co., Cleveland, Ohio.
- 756-757—Lamie Chemical Co., Huntington, W. Va. Dyestuffs. Dr. K. E. Schlossingski; A. Shafer; R. Z. Emig.
- 733—Laurel Soap Mfg. Co., Philadelphia, Pa.
- 627—Liberty By-Products Co., New York City.
- 633—Loomis Manning Filter Distributing Co., Philadelphia, Pa.
- 734—Lucerna Chemical Co., Trenton, N. J.
- 620—Maas & Waldstein Co., 92 William St., N. Y. Lacquers and enamels. H. C. Flanagan.
- 658—Magnesia Association of America, Philadelphia, Pa. 85 per cent. magnesia pipe and boiler covering. G. S. Stuart; J. W. Quinn.
- 675—Mine Safety Appliance Co., Pittsburgh, Pa.
- 629—Mobile & Ohio R. R. Co., Washington, D. C.
- 677—Majorian Bros. Co., Chicago, Ill. Laboratory specialties. T. Majonnier; F. D. Courtenay; J. J. Majonnier; Roscoe Moon.
- 661—Mono Corporation of America, 25 W. B'way, N. Y. Combustion recording instruments. F. D. Harger; O. Roohie; C. Snyder; D. W. Reid.
- 611—Morse Chain Co., Ithaca, N. Y.
- 634—Nassau Valve & Pump Corp., Rockville Centre, N. Y. Chemical valves and pumps. A. T. Haviland; E. J. Walsh; H. E. Evans; C. Schmitt.
- 718—National Binding Machine Co., 240 West St., N. Y. Sealing machines for corrugated and fibre boxes. T. R. Gautier; A. E. Rideout; M. McFauli; W. D. Kimball.
- 739—Nelson, Alfred W., Brooklyn, N. Y. Filter press. Harry Dunning.
- 639—New England Tank & Tower Co., Everett, Mass.
- 626-628—New York Color & Chemical Co., 98 John St., N. Y.
- 728—New York Container Co., Inc., 105 Hudson St., N. Y. Fibre containers. A. W. Hills; S. N. Stevens; C. H. Andrews.
- 666—Nitro Products Co., 501 5th Ave., N. Y.
- 683—Northwestern Chemical Co., Wauwatosa, Wis. Organic acids, esters, and synthetic dyes. R. L. Wilson.
- 730—Pneumatic Scale Corp., Ltd., Norfolk Downs, Mass. Packaging machinery. R. N. Doble; A. H. Axberg; A. C. Hastings, Jr.; E. W. Morgan.
- 704—Foret Mfg. Co., North Newark, N. J.
- 698-699—Power Specialty Co., 111 B'way, N. Y.
- 659—Powers Regulator Co., 101 Park Ave., N. Y. Automatic temperature control apparatus. O. F. Weillbacker; F. A. Murray; H. W. Feige.
- 744—Powhatan Mining Co., Baltimore, Md. Asbestos and products. Fred A. Mett.
- 640—Proctor & Gamble Distributing Co., Cinn., Ohio.
- 702—Protecto Safety Appliance Co., Newark, N. J.
- 665—Raritan Aniline Works, Lincoln, N. J. Aniline oil, nitro-benzol, etc. W. H. Van Winkle; N. D. Wellman.
- 760-761—Rhodia Chemical Co., 135 Cedar St., N. Y.
- 731—Scott & Co., Henry L., Providence, R. I. Testing machines. D. C. Scott; Gordon Stanton.
- 693—Simmons Co., John, 110 Centre St., N. Y.
- 709-710—Sly Mfg. Co., W. W., Cleveland, Ohio.
- 632—Southern Cotton Oil Co., 120 B'way, N. Y. Cottonseed by-products. David Wilson.
- 629-630—Southern Railway System, Washington D. C. Southern resources and opportunities. W. C. Olds; C. G. Gilbert; Robt. F. L. Barren.
- 627—Stamford Extract Mfg. Co., 141 B'way, N. Y.
- 610—Sticht & Co., Herman H., 15 Park Row, N. Y. Indicating and recording pyrometers and thermometers, gas air and CO₂ instruments. H. H. Sticht; F. J. Lauterbach; H. J. A. Hackenburger; W. North; J. H. Kneib.
- 762-763—Takamine Laboratory, Inc., 12 Dutch St., N. Y. Chas. S. Tanner Co., Providence, R. I. Pharmaceuticals and specialties. C. M. Tanner; J. E. McHenry; W. S. Newell; J. W. Coleman, Jr.; Alice George.
- 680-681—Technical Products Co., Inc., 501 5th Ave., N. Y.
- 747-748—Texas Gulf Sulphur Co., 50 E. 42d St., N. Y.
- 666—Thatcher Process Co., Syracuse, N. Y.
- 721-728—Tyler Co., The, W. S., Cleveland, Ohio. Screening machinery. H. E. Brown; W. P. Cahall; R. Driscoll.
- 665—Uniform Chemical Products Co., Perth Amboy, N. J. Benzidine base and sulphate. W. H. Van Winkle; H. D. Wellman.
- 738—Universal Oil Co., Wilmington, N. C.
- 732—Universal Dyes & Chemical Co., Milwaukee, Wis.
- 676—Wailes Dove-Hermiston Corp., 17 Battery Pl., N. Y. Acid-proof paints. R. B. Nesbit; H. W. Cronk.
- 768-771—Warner Chemical Co., 52 Vanderbilt Ave., N. Y. Chemicals. Nelson cell. Jno. H. Chew; Wm. B. Thom; S. C. Mastick.
- 654-655—Wheeler Mfg. Co., C. H., Philadelphia, Pa. Air pumps, condensers and regulators. Chas. Lang.
- 766-767—Wolf & Co., Jacques, Passaic, N. J. Specialties for textile industry. Dr. A. Pfister; W. D. Deuble; J. W. Gross; F. G. Henckel; R. S. Griffith; J. F. McDonagh; A. J. Royce; G. J. Desmond.

Allied Chemical & Dye Corporation

The merger of five chemical corporations into a unit, which will be the largest single factor in the world engaged in chemical manufacture marks the demise of the separate existence of the Barrett Co., General Chemical Co., Solvay Process Co., Semet-Solvay Co. and the National Aniline & Chemical Co.

The combined capital of the five companies consists of \$5,907,740 bonds, \$26,294,660 preferred stock, and 1,095,781 shares of common stock, of which all but the 395,990 shares of the National Aniline & Chemical Co. have a par value of \$100 a share.

The combined earning power cannot be estimated as income accounts are not in every case available. General Chemical Co. and Barrett Co., however, have shown consistently large earnings. From 1913 to 1919, General Chemical showed a range of earnings applicable to stock of from \$2,809,442 in 1913 to \$12,286,836 in 1916. In 1919 it earned \$5,370,005. In the first six months of 1920 General Chemical earned \$13.40 a share on its common stock.

Earnings of the Barrett Co. in the same period have ranged between \$1,835,811 in 1913 and \$4,247,858 in 1916. Last year the company earned \$1,999,775 for dividends. Earnings are only reported annually, but it can be stated that the showing of the first six months indicated a net for the year of over \$5,000,000, a record level.

The following table shows the capital of the five companies:

	Bonds	Pfd. Stock	Com. Stock
Barrett	\$1,846,000	\$7,811,400	\$16,443,100
General Chemical		16,333,000	19,822,000
Solvay-Process	4,000,000		16,739,000
Semet-Solvay ...	61,740		16,974,000
National Aniline.		21,150,260	Shs. 395,990

Total. \$5,907,740 \$45,294,660 \$109,485,100

Upon the completion of the organization of the new company, stockholders in the present companies will exchange their shares for shares in the new company on the following basis agreed upon by officials of the various companies:

Preferred stock—General Chemical 6 per cent., par \$100, will be exchanged par for par for new 7 per cent. preferred stock of the consolidated company; Barrett Co. 7 per cent. preferred stock to be exchanged on the basis of \$116.66 in new 7 per cent. preferred for each old share; National Aniline & Chemical Co. 7 per cent. preferred to be exchanged par for par for the new issue of preferred.

Common stock—General Chemical Co., 2.6 shares of new no par value common stock for each old share of common; Barrett Co., 2.29 shares of the new for each old share; Solvay Process Co., 3.16 shares of the new for each of the old; Semet-Solvay Co., 2.66 shares of the new for each one of the old; National Aniline & Chemical Co., 1.4 shares of the new for each share of the present common stock.

The new preferred stock will be issued in sufficient volume to cover the exchange of shares only.

Personal Items

W. E. Schratweiser, 120 Liberty street, N. Y., has been appointed New York representative of Lever Bros. Co., Cambridge, Mass.

* * *

Eugene H. Hickson, formerly a chemist with the Bureau of Standards, is now with the American Writing Paper Co., Holyoke, Mass.

* * *

William S. Culberson, of Kansas, has been reappointed by President Wilson as a member of the Tariff Commission.

* * *

George T. Mager, formerly of the Atlas Finishing Company, 46 Union Square, New York, is now associated with the Cosmos Dyeing & Printing Company, Paterson, N. J.

* * *

Phineas Kent, Jr., and David G. Wallace, respectively, will have charge of two branch offices of Geigy Co., Inc., 89 Barclay St., New York, recently opened at 64 West Randolph St., Chicago, and Columbus, Ga.

* * *

Benjamin Thomas, chemist, with the Monsanto Chemical Works, St. Louis, Mo., has been sent by his company to England to supervise manufacturing work at its English plant.

* * *

Dr. Curtis W. Thing, of the University of Washington, and A. A. Tushin, of the Massachusetts Institute of Technology, are recent additions to the research staff of the Brown Co., Berlin, N. H.

* * *

Ralph A. Gould and Bryant S. Drake, chemical engineers, announce their association as a partnership under the firm name of Gould & Drake, chemical engineers, with offices at 216 Pine street, San Francisco, Cal.

* * *

Will V. Norris has accepted the position of assistant professor of chemistry at the Colorado School of Mines for the coming year. Professor Norris formerly held a similar position with the Texas Christian University, at Forth Worth, Tex.

* * *

E. H. Heumann, chemist, and Charles H. Breed, metallurgist, formerly with the Crown Cork & Seal Co., Baltimore, Md., are now associated with Daniel M. Luehrs, consulting industrial engineer, Cleveland, Ohio.

* * *

W. L. Miles has disposed of his interest in the Wickes Machinery Co., Jersey City, N. J., and now devotes his entire attention to the Miles Machinery Co., Saginaw, Mich., dealer in new and used machinery and industrial properties.

* * *

J. Van Akeren, operating superintendent, and H. Lee, contracting engineer, Koppers Co., Pittsburgh, Pa., have returned from abroad after several weeks' inspection of European by-product coke plants.

* * *

James Beveridge, well known as a pulp and paper expert, is now general manager of the Hummel-Ross Fibre Corporation, which has established a kraft pulp and paper plant at the former munitions town of Hopewell, Va.

The many friends of C. G. Campbell, sales manager of the Kewaunee Manufacturing Co., manufacturers of laboratory equipment, Kewaunee, Wis., will be pleased to learn of his promotion to the position of general manager and election to the board of directors.

* * *

J. Schanzenbach, formerly with the chemical department of Laidlaw, Kelley & Co., Thompson street, N. Y., is now with Bech, Van Sicken & Co., Inc., 45 East 17th street, N. Y., in charge of the import chemical department.

* * *

C. E. Bales, formerly in the refining department of Standard Oil Co. of Kentucky, is now in the chemical-geological department of the Louisville Fire Brick Works, Louisville, Ky. He has also been made a field assistant of the Kentucky Geological Survey.

* * *

Charles Jewell Parsons has been added to the sales staff of the New York office of the Celite Products Company, 11 Broadway, New York, manufacturers of heat insulating products. Mr. Parsons is a specialist in power plant work and is a graduate of the Massachusetts Institute of Technology.

* * *

William Wrigley, Jr., of Chicago, head of the Wrigley chewing gum business, has entered the beet sugar industry in Utah, where with W. Harvey Ross and R. T. Harris of Salt Lake City and O. H. Egge of Santa Barbara, Calif., he is reported to have acquired control of the Gunnison Valley Sugar Company.

* * *

M. B. Jasspon, formerly manager of the National Chemical Products Co., 135 William street, N. Y., is now located at 30 Church street, doing business under the trade name, Atlantic Chemical Products Co., where he will deal in chemicals, dyestuffs and intermediates.

M. Gerstle is now in charge as manager of the New York office of the National Chemical Products Co.

* * *

H. M. Gaylord, formerly assistant Federal Prohibition Commissioner at Washington and prior to that Deputy Commissioner of Internal Revenue in charge of Distilled Spirits Division, has been elected a vice-president of the Kentucky Distilleries & Warehouse Co., a subsidiary of the United States Food Products Corp., 56 Pine St., N. Y. He will supervise operations of the industrial alcohol plants of the company.

* * *

R. J. Quinn, western editor of CHEMICAL AGE and secretary of the Chicago Section of the American Chemical Society, has been appointed Chicago district sales manager of the Mathieson Alkali Works, with local offices at 327 S. LaSalle street, Chicago. Mr. Quinn has wide acquaintanceship among mid-continent chemists and chemical industries and will be a capable assistant to Mr. J. A. Kienle, director of sales of the Mathieson Alkali Works.

* * *

W. C. Phalen, of the U. S. Geological Survey, is a recent emigre to private industry. He is now geologist with the Solvay Process Co., Syracuse, N. Y.

* * *

Paul F. Webster, formerly research chemist with the Larkin Company, Buffalo, N. Y., is now in charge of oil refining at the new plant of the East Aurora Vegetable Oil Refineries, Inc., at East Aurora, N. Y.

Industrial Notes

J. C. Whitlam Mfg. Co., paints and enamels, Wadsworth, Ohio, is enlarging its plant by the construction of a 40x70 addition.

* * *

American Chicle Co., 19 W. 44th street, N. Y., will erect a new plant in Kansas City, Mo., of twice the capacity of present plant.

* * *

The Electric Storage Battery Co., Philadelphia, has filed plans for a one-story addition on Rising Sun Lane, near Adams road, to cost about \$20,000. Plans for a new three-story brick and concrete plant to cost \$192,000, have also been completed.

* * *

The construction of the immense refinery of the Standard Oil Co. of Ohio on Maumee Bay at Toledo is making such progress that portions of the refinery will be in operation by the new year. For modern equipment, size and pipe-line connection with the mid-continent fields, this project is notable in the development of the technology and distribution of petroleum products. The site comprises 1,200 acres.

* * *

The Metals & Chemicals Extraction Corp., Granville Moore, president, has completed an addition of 20 tons daily capacity to its Oakland, Cal., plant for the production of lithapone. This is the only lithapone plant west of the Mississippi.

* * *

Procter & Gamble Co. engineers and architects are now engaged on plans for the construction on its recently acquired 54-acre site on San Francisco Bay, of plant, harbor and shipping facilities requiring an investment of \$3,000,000.

* * *

Corn Products Refining Co. has bought from the North Kansas City Development Co., Kansas City, Mo., a 75-acre tract as a site for its new western plant. Construction and equipment will involve an investment of \$7,000,000. The plant will have a daily capacity of approximately 25,000 bushels of corn.

* * *

The Coco-Cola Co. will erect on a 4½-acre tract at Baltimore, Md., a four-story 190x600 plant, costing \$1,000,000.

* * *

The Louisville Chemical Co., E. F. Gregory, president, Louisville, Ky., has increased its capitalization from \$25,000 to \$50,000 and will erect a three-story factory.

* * *

George L. Lamden and William Leckin, of Cincinnati, Ohio, have purchased the Kraver distillery at Henderson, Ky., and will remodel it for industrial alcohol production.

* * *

The Federal Chemical Co., fertilizers, Columbus, Ohio, will erect a 122x167 plant addition costing \$100,000. Chemical Construction Co., Charlotte, N. C., has the contract.

* * *

Directors of Brunner, Mond & Co., Ltd., of Great Britain, by resolution passed by shareholders, have been directed to distribute to such universities or other scientific institutions in the United Kingdom as they may select, £100,000 for the advancement of scientific education and research.

Bethlehem Laboratories, Inc., Bethlehem, Pa., will erect a \$75,000 plant on a 7½-acre tract at that place, for the manufacture of antiseptics.

* * *

The Eau Claire Paper Mfg. Co., Eau Claire, Wis., capital \$400,000, has been incorporated by W. L. Davis, Claude Hayden and William Brubacher of that city, to manufacture filter paper for technical purposes.

* * *

A recent sale of ten shares of the Eastman Kodak Co. stock on the New York Stock Exchange at \$533 is notable as the first sale recorded in five years, the last previous sale having been in August, 1915, with the price \$605 a share.

* * *

The Aquatile Enamel Products Co., Walton, N. Y., has been incorporated with a capital of \$300,000 by W. J. Lawrence, C. N. and J. N. Peak, Walton, to manufacture enamelware specialties.

* * *

The Metal & Thermit Corporation, 120 Broadway, New York, has made arrangements to secure life insurance for all its employees who have served the company for at least six months. The amount of protection is graded according to the length of service, ranging from \$700 for six months' service up to \$3,000 for twenty years' service. The company bears the entire expense of this insurance, which is in addition to any compensation to which its employees might be entitled under the present state compensation laws. The insurance will be paid in monthly payments during the first year after death.

* * *

The Leeds & Northrup Co., Philadelphia, manufacturer of electrical measuring instruments, has taken title to about three acres on Germantown avenue, near Wayne Junction, for a consideration of about \$35,000. The site will be used for the erection of a new plant.

* * *

Hercules Powder Co., for the six months ending June 30, earned, after preferred dividends, \$15.03 per share on its \$7,150,000 common stock. In the post-war adjustment period of the corresponding six months of 1919, net earnings were \$4.21 per share on the common stock.

* * *

Standard Utramarine Co., Huntington, W. Va., will enlarge present facilities by the erection of 1-story and 3-story plant additions.

* * *

Color Works, Inc., New York City, has acquired the former power plant of the Morris County, N. J., Traction Co., and will convert it into a dyestuffs plant.

* * *

Alcohol Products Corporation, 30 Church St., New York, will construct a \$50,000 addition to its plant at Monmouth Junction, N. J.

* * *

The Dorchester Fertilizer & Lime Co., Cambridge, Md., has been organized to take over the plants and businesses of L. L. Webster & Son, and Andrews & Skinner, manufacturers of fertilizer. The new company is planning for extensions in the plants, to include the installation of new crushing machinery and other equipment. Lloyd Webster is president and treasurer.

The Pride Pulp & Paper Co., Tomahawk, Wis., has tentative plans and specifications for its proposed paper and pulp mill, which will cost approximately \$3,000,000 including auxiliary buildings, water power improvements, etc. The first unit will contain three machines with a capacity of 75 tons of catalog book paper daily. C. B. Pride is president and general manager.

* * *

Employers in New York State who come under the Workman's Compensation Law are warned to carry compensation insurance to cover their employees, or else they are liable to a fine up to \$1,000 or imprisonment up to one year, or both fine and imprisonment.

* * *

The Hyco Fuel Products Corporation, 276 Fifth avenue, N. Y., has purchased a large tract at Edgewater, N. J., for use in demonstrating its motor fuel. Dr. Allen Rogers is consulting chemist.

* * *

The Eastman Kodak Co., Rochester, N. Y., has organized a subsidiary company to be known as the Tennessee-Eastman Corporation to construct and operate its proposed new plant at Kingsport, Tenn. The new company has a capital of \$1,000,000. The works, with equipment, is estimated to cost about \$250,000. George Eastman is president, and James Havens, secretary.

* * *

The Metal & Thermit Corporation, New York, has acquired 12 acres in South San Francisco, Cal., and will erect a plant which will employ 300 men.

* * *

The Gund Brewing Co., LaCross, Wis., will convert its cooage department into a factory for manufacturing metal tables with porcelain tops and other furniture specialties. Production will commence about Sept. 1.

* * *

Edward G. Acheson, head of the Acheson Graphite Co., Niagara Falls, N. Y., manufacturer of electrodes, lubricating products, etc., has organized the Acheson Products Co., Inc., under Delaware laws, with capital of \$1,000,000, to manufacture similar specialties and other mechanical equipment. Other incorporators are Frederick F. Seary, Paterson, N. J., and John S. Parker, South Orange, N. J.

* * *

The United Chemical & Supply Corporation, Ridgewood, N. J., has been incorporated with a capital of \$100,000 by Frederick V. Watson, John F. Moran and H. V. Watson, to manufacture railroad torpedoes, signals, etc.

* * *

E. I. du Pont de Nemours & Co., Wilmington, Del., have leased over 150 acres in the vicinity of Millville, N. J., and are reported to be arranging for the erection of a new plant. Surveys are now being made.

FOR SALE

FOR SALE—Compete metallurgical laboratory with small stock of chemicals. Equipment in use about six months and is in first-class condition. Address: Metals, care CHEMICAL AGE.

VACANCY

WANTED—Librarian for Department of Chemistry, prominent college, metropolitan district, Man wanted. Initial salary \$1,400; prospects for advancement. Address A-7, care of CHEMICAL AGE.



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Co-operative Chemical Research

The war gave applied chemical research the greatest impetus that science has ever known. In keeping with its progressive program, The New Jersey Zinc Company has recently built the most extensive, most completely manned and best equipped research laboratory in the field of zinc.

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How the Packer Views the Chemist

By Thomas E. Wilson

President, Wilson & Co.

THE application of chemistry to the packing industry and the recognition of the science as the basis of the industry have been within the memory of men now active in the business and who would resent the charge that they are growing old.

I have lived through this period and have been a part of its progress and expect to see the attainments of the chemist in the food industry surpass his past achievements.

When as a boy I entered upon my first job in the Union Stock Yards in Chicago, by no flight of the imagination of the very practical men who laid the foundations of the industry could a chemical laboratory be conceived. H. B. Schmidt, of Cincinnati, Ohio, was the pioneer chemist of the Stock Yards. Looked upon as an ornament, a concession as it were to the higher learning, and the laboratory as a luxury, you can imagine the trials and tribulations that beset Mr. Schmidt in his sole occupancy of a ten-by-ten laboratory.

Trifling today, the expense then was big in relation to results. To justify his job, to forestall the criticism of "all going out and nothing coming in," the first scratch upon the surface of the untouched field of packing-house chemistry was Schmidt's introduction into his box-stall laboratory of a vacuum pan for the making of extract of beef.

This was the battle of the Marne of the pioneer packinghouse chemist. That vacuum pan turned the tide of adverse criticism and gave Schmidt the prestige inherent in a profit and enabled him to show from month to month earnings for that department.

The "beef barons" of those early slaughter-house days stepped out of the role of butchers and, with the



THOMAS E. WILSON
President, Wilson & Co.

achievements of applied science in this exacting business, became known as packers.

The commercial arithmetic of the early days of the industry comprised the balance between the cost of the live animal and the proceeds of the sale of the carcass. Today the income of dressed beef sales is less than the cost of the animal on the hoof.

The salvation of the packing industry resides in the disposition of the by-products of the carcass. This shifting of the incidence of profit has been to the advantage of the consumer and is the work of the chemist. I know of few contributions to human welfare of greater value. Without the elaboration of by-products and the development of markets continually demanded by the increased value imparted to them by the refinements of separation and manipulation, dressed beef would not have the place in the American dietary that it holds today, nor would the material progress of our vast agricultural domain be possible.

We have used the industrial scientist in this business to apotheosize the slaughterhouse. He made our products the necessities of the world and our industry the commissary of the Allied forces.

The analytical chemist controls our manufacturing processes, maintains a progressive standard of quality in our products and makes possible the now common practice of trading on specifications whereby the interests of seller and buyer of by-products are protected and their maximum value realized.

The research chemist solves the perplexities of hitches in the even tenor of production; he answers the complaints of consumers by the removal of conditions

that give them rise; he introduces efficiency in manufacturing procedure by his ever constant study for its improvement; he finds new uses for old products and by raising the commercial dignity of humble things he endows with value what formerly was worthless. Truly the research chemist in the packing-house has made a "silk purse out of a sow's ear."

The chemical engineer is a plant man of administrative capacity. He knows how to handle help, to maintain discipline, to develop loyalty, to reduce costs of production by the introduction of those conditions, whether of equipment, apparatus, or the disposition of labor, whereby the maximum output may carry the minimum burden of manufacturing cost; all to the end of increased profit which the packing industry is pre-eminent in its exemplification of the economic law that it passes on to the consumer in the saving of reduced prices.

The business chemist is the coming man of the chemical world. In fact he already has arrived, for he dominates the policies of every chemical enterprise and sits in the councils of the industry. His work is the aspiration of every energetic, ambitious, chemically educated young man, for he represents the maximum business usefulness of the intelligence of his tribe.

The by-products must be sold. They will not always sell themselves. The business chemist out-thinks rather than out-talks the buyer and on him we depend for the extension of the markets of distinctively technical products. The members of the administrative staff must be of this breed of men.

The analytical chemist, the research chemist and the chemical engineer each has his place in the manufacturing organization. As aptitude develops with experience the business chemist is evolved out of the ranks of industrial scientists into the logical leader of the industry.

My own organization started with one chemist and now we have nearly a hundred of all kinds and descriptions whose work in the study of the almost infinite details of a world-ramifying business has made possible its development to its present stage.

I do not want to neglect this opportunity to instill in the readers of CHEMICAL AGE a sense of proportion, a sense of the eternal fitness of things, in its judgment of the work of a public servant in the misunderstanding accompanying the charges of government-by-commission in its consideration of the service of the packing industry.

Technical men know what efficiency means. They are educated to practice it in the production of goods and to inculcate its philosophy in those whose labor they direct.

In 1919 the five large packers did a business of \$3,521,000,000; their profit on this turn-over was \$34,500,000. To do this volume of business and to make this profit, they handled almost 40,000,000 head of live-stock at a profit of 87½ cents per head, or less than one cent on each dollar of business done.

If the products had been sold entirely to the American people the aggregate profit would represent 65 cents profit per person per year.

Can you wonder how compelling is efficient management in the collection of our raw material, the production of our goods and their distribution throughout the world? Applied science hath no greater triumph!

As a student of technical conditions in our business and of world-wide economic conditions that affect the distribution of our products, and always as an observer of men, I believe that technical men are due for a

recognition the retardation of which is due partly to previous economic conditions and partly to themselves.

No civilized country surpasses us in material accomplishments attained in a region of marvelous plenty.

Just as Mr. Schmidt in his tiny laboratory in the slaughter-house of early Stock Yards history turned back the tide of derision and complaint by the production of results, so I believe the fundamental industries of the country have reached a turning point. In attaining the peak of volume production we have used lavishly of our natural resources and of our raw material. Under the lash of compulsion we must practice conservation and from our raw material distil undiscovered products by the alchemy of research.

Our natural resources of material and power in their intensive development will call with increasing insistence upon the services of technical men.

Cooperation will be the keynote among men in their respective contributions to the solution of the problems of human welfare.

Technical men must learn to be "mixers" among men as well as with the stirring rod and to drop the lingo of the laboratory in their contact with business men. They must consider their scientific attainments from the standpoint of human service and realize that what they know can be made effective in that service only to the degree that they can translate it into dollars and cents which are the common denominator of business.

In this practical world the man who can do things always dominates the man who merely knows.

U. S. Industrial Alcohol Co.

Although transportation difficulties interfered with business of U. S. Industrial Alcohol Co. during the current year, the company has made progress enabling it to continue the 8% dividend on its stock. It is expected that the present dividend will be earned by a good margin, and increased earnings are in prospect.

U. S. Industrial Alcohol Co. has not pushed the production or marketing of alcosas, its patented fuel for motors, for the reason that the demand for commercial alcohol at high prices has consumed capacity production and made it more profitable to sell alcohol under present conditions. The company is in a position, however, to resume extensive operations in alcosas whenever the demand for alcohol falls off and prices decline.

Despite a liberal dividend policy for a number of years, U. S. Industrial Alcohol Co. has made extensive expansions and at the same time built up its working capital. At the end of last year net working capital was \$9,164,733 against \$1,946,019 as of December 31, 1918. Of this amount \$5,503,604 was in cash and Liberty Loan bonds. Net tangible assets applicable to common stock were \$36,493,208, or \$152 a share.

In 1917, the company earned 54.67% on the common stock and in 1918 it earned 51.68%. During the year 1919, common stock was increased from \$12,000,000 to \$24,000,000. Earnings on an average amount of common stock on which dividends were paid during the year was equivalent to 17.61%, or \$10.06 a share on \$24,000,000 common stock for the full year.

The American Cellulose and Chemical Mfg. Co., Ltd., 681 5th avenue, N. Y., with plant at Cumberland, Md., for the production of cellulose acetate, will expand its manufacturing facilities by the erection of a plant for the transformation of cellulose acetate into the artificial silk filament.

Cost Records of Production in Chemical Manufacture

By E. W. McCullough

Manager, Fabricated Production Department,
Chamber of Commerce of the United States.

ONE of the most effective ways to correct deficiency in manufacturing methods is accuracy and system in the determination of costs of production. In wartime production, prompt delivery and volume of output were the main desiderata. Details of production costs were sacrificed in the scramble to turn out the goods.

Chemical manufacture differs from no other industry in the necessity of accurate records of production costs which necessity will become more urgent in the keen competition incident to the deflation now in general progress. Chemical manufacture, in that it deals with the transformation of matter under conditions not only of the personal equation of the operator but affected by temperature, pressure and the numerous influences determining percentage yield, differs not only strikingly from many lines of manufacture, but displays that wide variety of production methods incident upon the almost infinite variety of chemical reactions.

My purpose will be served if I can stimulate production managers in the chemical industries to greater insistence upon accurate cost-keeping records, for no other activity in production has greater potentiality on the one hand, for increased efficiency and, on the other hand, for its unfailing indication of those responsible for deficiency or efficiency.

Primarily, a business to exist must make money. This means that something must be disposed of for more than it has cost. Every manufacturer, therefore, is vitally concerned with the two items—cost and profit. The problems presented in labor, materials, production costs, and keen competition have made it necessary for a manufacturer to determine and constantly to know the cost of his product in order that his business may continue to be a profitable one, and earn the margin of profit desired. There is a definite dividing line between profit and loss, and the location of this dividing line can be and should be accurately determined.

Cost accounting is an accurate method for arriving at the cost of producing a complete and saleable commodity and delivering it to the carrier for transportation, reporting in usable records all of the various elements which go to make up these costs. Records of costs are valuable in themselves, yet it is the detailed information which they contain, available for ready reference, which is of utmost value.

Accurate information regarding the various elements which go to make up costs, as contained in cost records, automatically eliminates arbitrary, empirical, or guess costs which prevail to a surprising degree among many manufacturers. The cost system, like an X-ray picture, brings to light imperfect internal conditions and suggests correction.

Functions of Cost Keeping

Among the many ways in which cost keeping is an aid to production are the following: It brings to light inefficiencies in system by calling to attention the cost of its operation and points out equipment that has become inadequate by showing an excessive cost of product coming therefrom. It points out employees who are below the standard required, and permits of performances being kept within certain limits by watching the

accumulation of costs. Increased production depends largely on the intimate knowledge the management has of all elements in their manufacturing operations which can only be supplied through an adequate cost system. It enables them to establish proper control and increase output as warranted by the cost record.

Checks Variations from Standard Practice

In many plants considerable sums of money are spent to establish a standard practice of operation. From time to time certain variations from the established standard practice occur, affecting costs in an adverse way. Timely cost reports showing what is happening, rather than what has happened, suggest immediate correction of such inefficiencies. It is not sufficient that executives simply know that expenditures are excessive; they should be supplied with information to determine exactly where these excessive expenditures occur and take action. Definite responsibility for expenditures as well as the authority to make the expenditures should be fixed by an adequate system of cost accounting.

Helps in Controlling Overhead or Burden

Overhead, or burden, consists of expense items which cannot be directly attributed to some particular product. It is composed of indirect labor and material, rent, etc. Overhead being variable, as related to output, and forming a material portion of a plant's expense, it is necessary that control over these accounts be rigidly kept.

Control is possible only when accurate knowledge of the amounts entering into each item composing overhead are known. Guessing, or estimating amounts of overhead, as well as arbitrary distribution without a sound basis for the allocation is uncertain and leads to unexpected results. Sales price does not affect overhead, but the amount of overhead definitely and absolutely affects sales price.

A factory manager should have before him detailed cost reports showing the expenditures necessary to produce articles. With this information at hand, he is in a position to note the variables and put into operation the movements necessary for their satisfactory control. In this respect, the cost system is similar to the nerve system of the body, its function being to transmit information regarding conditions in the entire plant to some central individual or body.

Promotes Intelligent Competition

No one enters business to fail but the majority who do lose out do so from various causes, but principally because they disregard the question of costs. Your worst competition is largely from those who do not know what it costs them to produce and do business. When normal production returns, competition will force closer margins and costs must then be known. Why not now?

Determines Unprofitable Lines

The manufacturer who bases the sales price of his product on competition without regard to real cost, stands to sell his product at a closer margin than he desires and possibly at a loss. Whether the margin of

the profit is ample or not the existing conditions are not known until the date when damage done is beyond repair.

It is generally conceded that unprofitable lines should be discontinued. Where a variety of articles are manufactured in a single plant a cost system offers the only opportunity for determining positively those lines which are not profitable. Where a single article is manufactured timely information regarding costs can forestall a calamity.

The raw and semi-finished materials and finished stock are an important part of the assets of a company. Officials who do not properly account for them with respect to price, quality, and quantity, may arrive at a cost lower than is real. This means that profits will be shown as greater than they are. It is obvious that if dividends are paid on the basis of such profits, the capital of the company will be depleted.

As an Investment

A practical, usable cost system should not be complex, but lean toward simplicity. Neither should it require an investment out of proportion to the benefits to be acquired. It should be considered a piece of necessary equipment and treated accordingly; it will return its proportion of dividends on the money paid for it. The adoption of a cost system by a number in any indus-

try, made uniform as to fundamentals, will be found of the greatest benefit in promoting more intelligent trade practices.

Technical accuracy in costs, especially in lines involving minute operations, is not altogether desirable or necessary, but costs commercially accurate can always be obtained.

General

Cost systems, both as to manufacturing and selling, should tie in with the general accounting records so that financial statements drawn will reflect all conditions of the business accurately.

In the making of a budget, the greatest possible accuracy is desirable, and here, too, the cost records of the past years afford dependable information.

When a business operates without a cost system, it is in the same position as a boat without a rudder, tossed about by the winds and directed by sources outside of those supposed to be in control, and driven towards an end which is not definite and perhaps not the one desired.

As we catch up in production a new era of competition will ensue, and war-time margins will disappear. In their place will come percentages of profit earned by efficiency and determined by accurate cost reckoning.

Allied Chemical & Dye Corporation

The consolidation of the five premier chemical corporations of America dominant in their respective fields was in charge of a committee of stockholders, selected by their respective companies, and comprises:

Dr. William H. Nichols, chairman of the board of the General Chemical Company.

W. H. Nichols, Jr., president of the board of the General Chemical Company.

E. L. Pierce, president of the Solvay Process Co.

R. W. Swift, treasurer of the Solvay Process Co.

H. H. S. Handy, president of Semet-Solvay Co.

A. W. Hudson, vice-president, Semet-Solvay Co.

Eversley Childs, chairman of the board, Barrett Co.

W. Hamlin Childs, president, Barrett Co.

Orlando F. Weber, chairman of the board and president of National Aniline & Chemical Company, Inc.

Wm. J. Matheson, director National Aniline & Chemical Company, Inc.

Dr. Wm. H. Nichols is the chairman of the committee and Clinton S. Lutkins, 25 Broad street, is the secretary.

It was the opinion of the committee, after a careful study of existing conditions and future prospects in the chemical industry, that the interests of the stockholders of each of the consolidating companies would be best served by their consolidation into a single organization, which will continue the present business of each company and which will also, from time to time, enter upon other lines of chemical and related businesses as may be deemed advantageous.

In the committee's opinion each of the consolidating companies has demonstrated that it is the most efficient existing organization in its particular field of domestic chemical industry, viz., in brief:

General Chemical Company,	Acids,
The Solvay Process Company,	Alkalis,
Semet-Solvay Company	Coke and its By-Products,
The Barrett Company,	Coal Tar Products,
Natl. Aniline & Chem. Co., Inc.	Dye Stuffs.

These different lines of chemical manufacture are in great measure necessarily interdependent; so the pro-

posed consolidation will constitute a well integrated and largely self-sufficient organization, operating in various fields of chemical manufacture and highly efficient in each.

Among the advantages which the committee believes are to be derived from such a consolidation are:

Greater diversification of output and correspondingly greater stability of business; closer adjustment of the production of basic and intermediate materials to the requirements for manufacture of their derivatives; and greater financial strength—not to mention the various economies in operation ordinarily available only to an organization of the scope here contemplated.

It is, however, in the future development of the chemical industry that the committee believes the greatest advantages of the proposed consolidation lie. As compared with most of the other major industries, the chemical industry is young. Current developments in this industry are correspondingly more rapid and important than in the older lines of industry, and will probably so continue for many years.

For this reason intensive progressive research is—and will long continue—an especially important feature of the chemical manufacturing business. In the opinion of the committee, the promotion of such research, through combination of the material and personal resources of the consolidating companies, is alone a compelling reason for the proposed consolidation. It is believed that the technical skill, business ability and financial strength of the consolidating companies, if united, will definitely assure the development of a complete American chemical industry, such as is essential to the industrial independence of the country and to the national security.

The Allied Chemical & Dye Corporation is to have outstanding, on the present basis of exchange of stock, 393,743 shares of 7% cumulative preferred stock, par \$100, and 2,119,677 shares of common stock without par value. The total authorized preferred stock will be \$65,000,000, and the common, 3,000,000 shares.

desired, as in paints, rubber goods, linoleum, oil cloth and glazed paper, also in lithographic inks, as a base for lake colors and as a pigment by the U. S. Navy "battle-ship gray." It occurs in the market in pulp which is a paste containing about 30 per cent. of water, used chiefly by paper and lithographic ink manufacturers, and as a powder for pigment purposes.

Barium Carbonate

Barium carbonate is precipitated from a solution of barium sulphide by treatment with soda ash. Sodium sulphide is obtained as a by-product. It also can be prepared by injection of carbon dioxide into the barium sulphide solution, by which process, barium sulphide is not obtained. Barium carbonate is used chiefly in the manufacture of optical glass. Increasing use is found in the manufacture of flat wall paints; also as a raw material for barium peroxide and in the production of some kinds of enameled ware.

Barium Chloride

Barium chloride may be produced by treating with-erite (barium carbonate) with hydrochloric acid. It also may be prepared by treating the barium sulphide solution with calcium chloride. The commercial method of production is direct from crude barytes by roasting with coal and calcium chloride. It crystallizes with two molecules of water and is sold usually in the crystalline or powdered form.

Barium chloride is used largely in the manufacture of blanc fixe and of chlorides; as a mordant for fixing acid dyes on the inert base such as aluminum hydroxide or blanc fixe; in the purification of salt; as a water softener; as a chemical reagent in sulphur determinations; for certain medicinal purposes; and to some extent in ceramics and in the manufacture of certain photographic chemicals.

Barium Nitrate

Barium nitrate is the product of the addition of Chile saltpeter (sodium nitrate) to a solution of either barium chloride or sulphide.

It is used chiefly in the manufacture of barium peroxide; in pyrotechnics and signal lights for the green color and for certain explosive mixtures. Its medicinal uses are similar to those of barium chloride.

Barium Peroxide

Barium peroxide, or dioxide, is prepared from either barium carbonate or nitrate by reduction by heat to barium oxide which then is converted into the peroxide by heating to about 700° C. in a current of air free from carbon dioxide and moisture. It is used chiefly in the manufacture of hydrogen peroxide. Its function as a vehicle for oxygen makes it valuable as a bleach, especially in the blanket and straw hat industries.

Barium and Sodium Sulphides

Whenever a sodium salt is added to a solution of barium sulphide in the preparation of barium salts, there is produced in addition to the desired barium salt, sodium sulphide as a valuable by-product which has a large consumption in dye manufacture in the preparation of sulphur colors, especially sulphur black.

Barium sulphide is the intermediate barium compound from which the majority of other barium chemicals are obtained and is one of the essential materials in the manufacture of lithopone described in the August issue of *Chemical Age*. It is used with lime as a depilatory in leather manufacture.

Miscellaneous

Barium chromate results from the metathesis of soluble barium salts with sodium chromate. As lemon yellow or yellow ultra-marine it finds large use as a yellow pigment. Barium chlorate, prepared in a similar manner, is used in pyrotechnics and dyeing.

Imports

Germany furnished 66 per cent. of the imports of all barium chemicals (exclusive of lithopone and blanc fixe) in 1914, amounting to 19,299,702 lbs., valued at \$526,824. Ninety per cent. of this importation was represented by the carbonate, chloride and dioxide. During the last six months of 1919 barium chloride was imported to the extent of 1,069,396 lbs.; with which exception imports of barium chemicals since 1915 have ceased.

Production Cost

Representatives of the U. S. Tariff Commission conferred with producers and manufacturers in the compilation of production costs representative of general conditions in the industry.

The cost of mining crude barytes in western mines increased from \$5.30 per short ton in 1916 to \$7.74 in 1919, while the increase in southern mines was from \$3.89 to \$7.39 per short ton. This corresponds to an increase of 90 per cent. for southern mines and 46 per cent. for western mines. The cost of manufacturing ground barytes was \$11.21 per short ton in 1914; \$12.69 in 1916; and \$19.25 in 1919, an increase of about 70 per cent. from 1914 to 1919. The cost of producing barium chemicals during 1919 was \$0.0294 per pound for blanc fixe; \$0.0316 per pound for barium carbonate; \$0.0539 per pound for barium chloride, and \$0.197 per pound for barium peroxide.

The Commission, in its emphasis on the lack of adequate cost-finding methods prevalent in the barium chemical industry, does not wish to convey the impression that all companies manufacturing barium chemicals do not keep accurate cost records, but a number of the firms engaged in this industry lack adequate methods of cost accounting, and the data obtained from the records of these companies are at best an approximation of the true cost. This condition may be accounted for by the fact that the industry was developed under stress of war conditions, with emphasis on output rather than on economy of operation and on accurate cost records. Now that the industry is approaching more stabilized conditions, more attention should be given to cost accounting by those firms which now have inadequate methods.

The Industrial Sugar Co., Barclay Block, Denver, Colo., will spend \$1,500,000 in the erection and equipment of its new power plant and beet sugar refinery at La Salle, Colo.

* * *

James H. Rhodes & Co., manufacturers of chemicals, polishing materials, etc., 115 Fulton street, New York, have purchased an acre of land in the Degnon Terminal, Long Island City, on the water front with rail facilities, on which they are planning the erection of a building costing \$250,000.

* * *

Boldt Paper Mills Co., Chas. Boldt, president, Cincinnati, Ohio, will erect at New Iberia, La., a paper mill utilizing rice straw. \$350,000 will be invested in buildings and equipment.

The Mental Requisites of a Man to Earn \$2,000-\$3,000 Per Year at the Start as a Government Chemist

THE United States Civil Service Commission announces open competitive examinations for the positions of associate chemist, \$2,000-\$3,000 per year, and of chemist, \$3,000-\$5,000 per year, vacant in the Chemical Warfare Service, Edgewood Arsenal, Edgewood, Md. Upon these examinations other vacancies will be filled at the salaries stated or at higher or lower salaries, unless, in the interest of the service, it is found advisable to fill any vacancy by reinstatement, transfer or promotion.

Qualifications for Position of Associate Chemist

The applicant must qualify in at least one of the following subjects:

1. Advanced inorganic chemistry.
2. Analytical chemistry.
3. Organic chemistry.
4. Pharmaceutical chemistry.
5. Physical chemistry.

Education and Experience

The applicant must have had the education, or the education and experience specified in one of the following groups:

(a) A Ph. D. degree from a college or university of recognized standing, the major work for which was in the line of the optional subject selected.

(b) Graduation from a four years' high-school course or education equivalent to that required for such graduation, accepted for college entrance; graduation with a bachelor's degree from a college or university, such degree requiring the completion of at least 118 additional semester credit hours, of which at least 30 semester credit hours must have been in chemistry; and subsequent work of either a research or technical character along the line of the optional subject selected in quantity and quality sufficient to be regarded as equivalent to a Ph. D. degree. By semester credit hour is meant one lecture or recitation hour or two laboratory hours per week per semester.

(c) Graduation from a four years' high-school course or education equivalent to that required for such graduation, accepted for college entrance; and at least eight years spent in advanced inorganic, analytical, organic, pharmaceutical, or physical chemical work. Each year of chemical study in a college or university of recognized standing will be accepted in lieu of a year's chemical work.

Under the second subject applicants must show that they have had sufficient experience as an executive to be able to direct the work of several assistants.

Note.—Experience in research work on, or in the manufacture of, toxic gases will be counted as double time.

Writings.—Under the third subject the applicant should submit with his applications copies of any writings along chemical lines which he has published. Any unpublished manuscripts of work accomplished may also be submitted. In lieu of publications or manuscripts, however, or in addition thereto, the applicant may submit a thesis upon some chemical subject which would incorporate the result of his own investigations.

Added Qualifications for Position of Chemist

(a) At least two years' experience in research work or in industrial chemical work.

(b) At least six years' subsequent work of either a research or technical character and along the lines of the optional subject chosen.

(c) At least ten, instead of eight, years spent in advanced chemical work.

Under the second subject applicants must show that they have had at least one year's experience in an executive position as chief or assistant chief in a research laboratory, or as superintendent or assistant superintendent in a chemical plant.

Percentage Distribution of Qualifications

Applicants will be rated upon the sworn statements in this application and upon corroborative evidence in the following subjects which will have the relative weights indicated:

Subjects.	Weights
1. Education, training and experience.....	40
2. Experience and training as an executive.....	30
3. Original research work completed.....	30
Total.....	100

Bonus

After six months satisfactory service appointees at an annual compensation of \$2,500 or less may be allowed the increase granted by Congress of \$20 per month.

Conclusion

Study of the educational and experiential qualifications of chemists above set forth can excite not only admiration for the self-sacrificing loyalty of the capable men remaining in the Government scientific service, but wonder at the ingenuity of its administrators to attract capable men and to accomplish the results with the reduced personnel.

If originality, enterprise and an alert appreciation of the eternal fitness of things count for anything in technical journalism, our friends can be assured that no stone will be left unturned to arouse opinion to demand the correction of this deplorable situation. Conditions should be such that the brainiest men in the chemical profession should find in government employment that opportunity for service that would constitute a reward for ability and attainment and make its personnel a Legion of Honor in the science and practice of chemistry.

Progress is the result primarily of the labor of exceptional men. So long as government maintains a scientific service for the development of our natural resources and for the stimulation of improved processes for their utilization it should conduct this service with a degree of efficiency that should be the emulation of private industry and not its quiet joke.

New Jersey Chemical Society

The New Jersey Chemical Society enters upon the third year of its usefulness with the first regular fall meeting on Oct. 11, at 842 Broad St., Newark, N. J., when Dr. H. A. Curtis, chief chemist, International Coal Products Corp., Newark, N. J., will deliver an address on "Low Temperature Carbonization of Coal," and Archibald Craig, of Ledoux & Co., New York, will discuss "The Status of Analytical Chemistry."

Carleton Ellis is president and J. A. Wilson, Duratex Co., Newark, N. J., is secretary. Chemists and all interested in the chemical industry, either resident in New Jersey or within the convenient transportation radius of Newark, are urged to co-operate with the officers of the society by attendance and participation in its meetings.

The society seeks to align every one interested in chemical manufacture and merchandising, from the laboratory and the plant to the sales staff, banker and the transportation agency, that the co-operation thus attained may have an influential voice in all matters affecting the progress of the chemical and allied industries.

Pottery Production in 1919

The year opened with unequaled prospects, most of the plants were kept going to the limit of the labor and material available, and at the end of the year many orders remained unfilled. The usual summer shut-down was confined to three days in July, including July 4. Labor troubles were limited to a few minor strikes, most of which were unauthorized by the unions. The principal handicaps to the industry were shortages of labor, materials and fuels. The railroad embargoes were also embarrassing, and some potters in the Ohio Valley resorted to shipments by water. The coal strike was a handicap, though not so great a one in the West, where natural gas is the principal fuel.

Better Ware Now Made

During the war the demand for pottery was so great and was so inadequately supplied that ware which would at other times have been rated as seconds or thirds was eagerly bought, but in 1919 an endeavor was made to improve the quality of the ware, especially in order to meet inevitable foreign competition.

Some years ago experimental work on bisque doll heads was done and a plant was equipped to manufacture them, but few were sold until 1919, when fine examples of the doll-makers' craft were put on the market.

Import and Exports

The demand for domestic pottery continued to be large, probably in part because the imports were small, though the value of imports in 1919 was greater than in the years from 1915 to 1918. Before the war we obtained most of our imported pottery from Europe, but during the war we imported increasing large quantities from Japan. In 1919, however, the imports from Japan fell off considerably and those from Europe increased.

Notwithstanding the enormous home demand the value of the exports in 1919 was greater than in 1918.

Production

The value of the pottery products of the United States in 1919 was about \$76,140,000, an increase of \$12,228,000 over that in 1918. The total increase in

1919 over 1917 was \$19,997,000, or 36 per cent., and over 1913, \$38,148,000, or 100 per cent. Every kind of pottery increased in value in 1919 except chemical stoneware and chemical porcelain. White ware (household wares except china) valued at \$29,700,000, showed the largest increase, \$4,394,000; sanitary ware, valued at \$14,480,000 increased \$3,239,000; china, valued at \$7,625,000, increased \$1,318,000; porcelain electrical supplies, valued at \$12,190,000, increased \$995,000; and red earthenware, whose output in 1918 was affected indirectly by curtailment of fuel, recovered in 1919 and was valued at \$1,160,000, an increase of \$253,000.

The value of white ware and china, which comprise the general household wares and constituted 49 per cent. of all pottery products in 1919, was \$37,325,000, an increase of \$5,712,000, or 18 per cent., over 1918. If to this sum is added the value of sanitary ware and porcelain electrical supplies, which formed 84 per cent. of the output in 1919, the total value was \$63,995,000, or \$9,947,000 more than in 1918.

Chemical Stoneware

The resistance of vitrified clay to chemical action, together with its impenetrability to liquids, has made chemical stoneware an important utensil in the chemical industries. Stoneware distilling kettles, receivers, filters, condensing worms, centrifugal pumps, acid-proof pipe, fittings, tower packing, acid-proof tanks, photographic tanks, and troughs and tubes for electrical processes are used in these industries. Stoneware equipment is also used in the preparation of foods, as, for example, sugar, flavoring extracts and preserves.

The production of chemical stoneware, which was used largely in the manufacture of munitions in 1918, naturally fell off with the cessation of hostilities, so that the production in 1919 was valued at \$645,000, a decrease of \$903,000. The decrease in chemical porcelain, valued at \$180,000, was \$42,000, and may possibly be ascribed to the same cause.

A wider use of chemical stoneware is limited only by its comparative brittleness and sensitiveness to sudden temperature changes.

Amalgamation in the Strawboard Industry

To protect its supply of raw materials, to insure expansion and an equitable distribution of straw for corrugating, the Mid West Box Co., manufacturers of fibre board products and solid fibre containers, with plants at Anderson and Kokomo, Ind., Cleveland, Ohio, Fairmount, West Va., and Chicago, has acquired the holdings of the estate of O. C. Barber, Akron, Ohio, in the American Strawboard Co., with plants at Quincy and Wilmington, Ill., Noblesville, Ind., Winchester, Va., Chestertown, Md., Circleville, Piqua, Tippecanoe, City and Barborton, Ohio.

Operation will be continued as two separate companies, the American Strawboard Co. remaining intact, save a change in the directorate. The new board of directors of the combined interests will comprise the following men from the American Strawboard Company: C. A. Palmer, vice-president and treasurer; C. D. Hawkins, general manager, and J. S. Smith, secretary; and the following men from the Mid West Box Company: J. P. Brunt, first vice-president; E. R. Hawkins, second vice-president, and K. I. Herman, secretary and general manager.

Expansion in Carbon Black Manufacture

The increasing demand for carbon black, particularly from the reaction of automotive activity upon tire manufacture, is reflected in the efforts of producers of this commodity in the wake of the natural gas and oil industry.

The Louisiana Carbon Co., C. W. Pettigrew, secy.-treas., Parkersburg, West Va., and J. A. Williams, vice president and manager, Clarksburg, West Va., capital \$200,000, has been organized to establish a carbon plant at Monroe, La., where the Fuel City Mfg. Co., contractors, will erect 24 single condenser buildings.

The Federal Carbon Co., Minneapolis, Minn., will construct at Phillips Station, La., a \$1,000,000 plant. At Sterlington, La., the Sterling Carbon Co. is building a plant.

The Southern Carbon Co., Fairbanks, La., will erect additional facilities on its 269-acre site at Swartz, La. At Wardville, La., the Diamond Carbon Co. is spending \$250,000 in plant additions. The industrial enterprises noted above are in the northeastern Louisiana gas field.

New Swedish Detonators

By Clas Herlin

The Alfred Nobel belongs the credit for the discovery of dynamite detonators. The percussion cap, designed not to initiate an explosion but to ignite the powder in the fire-arm cartridge, was invented in 1817; its main constituent was potassium chlorate. From 1831 to date fulminate of mercury, discovered by the Englishman, Howard, about 1800, has been used almost exclusively for this purpose.*

In Nobel's introduction of the industrial use of nitroglycerine, about 1863, he detonated the explosive with black powder, itself ignited by means of a fuse. The powder was contained in a small tube of glass or wood. (See Fig. 1.) The fuse was a single straw filled with black powder, which primitive device continued in use until Bickford, in 1831, invented his safety fuse. Nobel's use of a real detonator dates from 1864, when he used a mixture of black powder and fulminate of mercury, and later the latter alone. (See Fig. 2).

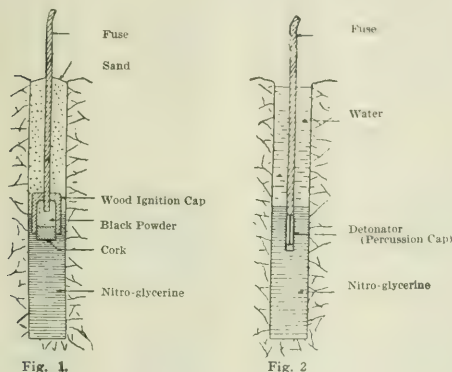


Fig. 1 Nobel's Method of Detonating Nitro-Glycerine

In 1887, Nobel patented an improvement in dynamite detonators which he called a "compound detonator," as it consisted of two distinct layers, one of fulminate, the other of picric acid. In 1900, the modern compound detonator, consisting of fulminate and TNT, appeared. The trinitrotoluene content was about two-thirds of the total fulminate usually used in the ordinary detonator. (See Fig. 3.) Later inventions consisted of mixtures of tetryl (tetranitromethylaniline) and fulminate. Sometimes the fulminate was replaced either partially or wholly by silver or lead nitride (Ag N_3 or Pb N_2). Lead nitride, however, has not proved to be altogether stable when stored in moist air containing carbon dioxide. Prior to 1918 no detonators or blasting caps were made in Sweden because of the efficient service of the local German explosive plants. The absorption of the entire output of the German plants for military purposes forced Swedish explosive makers to develop a detonator of their own, covered by German patent No. 319463, (see Fig. 4).

The New Detonator

This detonator is open at both ends, the explosive composition being pressed into the cap through the end which is to form the bottom of the finished product,

thus permitting (1) simplification of manufacture, (2) strengthening of force of initial explosion, and (3) a more secure attachment of the safety disc cover. If the safety disc were not used the greater part of the TNT would be thrown out by the force of the detonating fulminate without being able to take part in the explosion.¹

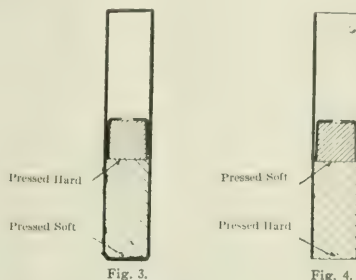


Fig. 3. Ordinary Detonator with Safety Cover (Washer).

Fig. 4. Bofors Detonator.

In order to induce an explosion in the insensitive but extremely powerful TNT when it is detonated, the fulminate must be packed in tightly. When this is done the force of the explosion is increased materially.

The transmission of the explosion of a detonating substance to an explosive of the TNT class is accomplished just so much more easily, the looser the TNT is packed. On the other hand, the initial explosive force and the shattering power of TNT itself increase with the pressure to which it is subjected in compression up to a certain limit. For this reason, in the manufacture of tetryl detonators in Germany, the compression of the explosive composition is carried out in several steps, as can be seen from Fig. 5, whereby in the first stage of the loading process higher pressures can be used. This leaves the material nearest the fulminate loosely compressed and so better able to transmit the detonation, while the explosive in the lower layers is compressed strongly and its brisance thereby materially increased.

It is evident that in each layer the surface in contact with the piston of the loading machine will be of greater density than the lower layers, when the loading is done, according to Fig. 3, i. e., from the open end towards the closed end. The topmost portion is compressed most compactly while the bottommost is compressed least.

By reference to figs. 3 and 4, it is evident that in the ordinary cap, the fulminate at the top or closest to the fuse where initial explosion ensues is hard while in the Bofors cap it is soft. This undoubtedly is an advantage in favor of the Swedish cap, for the softer the fulminate at point of contact with the fuse the more certain will be the propagation of the initial explosion. The Swedish cap is a "compound" cap, consequently use of a disc cover is required. American blasting caps are principally fulminate detonators and do not require the disc cover.

As the lower end of the Bofors cap is open, it would appear as if the force of the explosion would drive the TNT out of the detonator through that end even though the other end is closed by the safety disc. The lower end, of course, is the one that is inserted in the dynamite cartridge and, undoubtedly, some resistance would be offered to the ejection of the TNT from the detonator by the substance of the dynamite itself.

*Zeitschrift f. das ges. Schiess- u. Sprengstoffwesen, 1920, pp. 137-140. Translated by Ismar Ginsberg, Aetna Explosives Co.

When loading is done according to the Bofors process a theoretically ideal detonator is obtained, as the surface that is nearest the fulminate is compressed least so that the transmission of the detonation to the TNT or tetryl is facilitated, while the portion that is farthest away from the detonated TNT or tetryl is compressed most and its power is increased accordingly. Thus is gained considerable explosive force which facilitates the further transmission of the detonation to the next layer of TNT or tetryl.¹ (See Fig. 4.) In this way a very powerful cap is obtained. It has been proved that the German No. 6 detonator corresponds very closely to the Bofors No. 4. The latter cap makes a hole entirely through a lead plate 5 mm. in thickness.² The device used in making the test is shown in Fig. 6. The Bofors detonating cap is unaffected by atmospheric moisture in contrast with the ordinary fulminate of mercury cap.

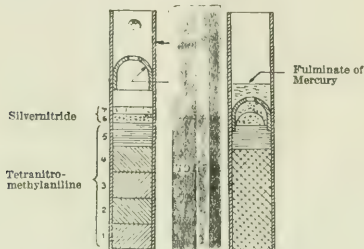


Fig. 5. Plan of Loading Tetryl Detonators

To determine the effect of moisture on different types of detonators, the cap is first placed in a desiccator filled with water, and then is fired on the lead plate.

Investigations showed that even after exposure to moisture in this manner for 110 days no change in strength of the detonator was observed.

Figures 8 and 9 show the effects of the explosion of a No. 4 German fulminate of mercury cap and a No. 4 Bofors cap on lead plates 4.5 mm. thick. Note the radiating markings on the plates which show to what degree the copper shells of the caps were disintegrated by the force of the explosion.

As result of the high price of copper and the desire not to advance the price of the detonator, steel has been substituted for copper in the material of the detonator shell. In this case the caps, after having been exposed to moist air for a period of over four weeks, deteriorated, probably because of the rusting of the metal.³ However, in actual practice it is hardly

possible that the caps would be exposed to the air for so long a time, as it is only after the box of caps is opened that the air can come in contact with the detonators.

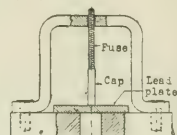


Fig. 6. Apparatus for Testing Dynamite Detonating Caps.

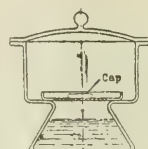


Fig. 7. Exsiccator (Desiccator Filled with Moist Air).

It is possible that a sediment of dust may accumulate in the packing-case, as the Bofors cap is open at the lower end. As this deposit consists of TNT only, its presence in the case is of no importance, as TNT is entirely insensitive to shock.⁴

It has been mentioned many times that, in the use of detonators provided with safety discs or collars, it is necessary to cut the fuse exactly at right angles to its length (Fig. 10), and not obliquely (Fig. 11); if the latter is done the finely pointed flame is directed amiss. Moreover a part of the powdered contents of the cap can push its way through the opening in the disc and as a result the cap may miss fire. However, a cap provided with a safety disc is much less subject to accidental explosion than the other type of cap; furthermore the fuse can be pressed down hard against the safety disc without danger of premature explosion.⁵

About a million of these caps have been made and sold. The present daily output is 15,000, with an expected increase in daily production to 60,000 within a few months, which production at the rate of 20,000,000 per year is in excess of Swedish requirements.

Superiority of the New Detonator

The inventor of the new detonator,⁶ Captain Wennerström, describes it as possessing important advantages over the ordinary detonator in manufacturing details. The fact that the shell is open at both ends makes it possible to produce these shells by first drawing out a long copper tube and then cutting it into suitable lengths in an automatic lathe, whereby a saving of 50 per cent. or more in copper is possible. Furthermore when the shells are made from copper strips by the stamping and drawing process a considerable saving in material also is effected from the fact that the shell proper can be formed and the protection collar inserted within the detonator in one operation.

In loading the caps the following advantages are possessed by the Bofors detonators:

¹ A steel shell detonator is not at all advisable, as there may be great danger of explosion in the operation of pressing the charge into the shell. The plunger of the charging machine is made from phosphor-bronze and as the material of the shell is copper there is no danger of a spark being formed when the plunger happens to strike accidentally against the sides of the shell. This may happen, however, when the shell is made from steel and result in an explosion. (Trans.)

² It, of course, is known that while TNT is insensitive to the ordinary concussions that may occur in the transportation of the cases, nevertheless it will explode when the shock is of extraordinary violence as in the firing of a shell from a gun. (Trans.)

³ The blasting cap made in the United States has an open end. The fulminate stays in place because it is pressed into a homogeneous compact mass with a high degree of cohesion to the walls of the detonator. (Trans.)

⁴ Patented by Aktiengesellschaft Bofors Nobelkrut.

¹ It is undoubtedly true that the Bofors system of loading is superior to American practice. In American detonators, the fulminate of mercury or the mixture of fulminate and potassium chlorate is filled loosely into the detonator, with the bottom end closed. Then pressure is applied by means of a piston plunger which squeezes the mixture into a compact mass. A mean pressure must be arrived at which will make the explosive mass dense enough to give an explosion of great shattering power, but not so dense that detonation takes place with difficulty and a considerable part of the fulminate burns away before detonation sets in. At any rate the most compact and thereby the most difficultly detonatable part of the charge is just at the wrong place, viz., where the explosion is initiated at the point nearest the fuse. The Bofors process is to be recommended highly and should result in a cap of greater effectiveness when all other conditions (weight of charge, etc.) remain the same, (Trans.)

² An American-made No. 4 cap (fulminate-chlorate composition) is not strong enough to penetrate a plate of this thickness. (Trans.)

(1) As it is entirely unimportant through which of the two open ends of the shell the loading is done, it is possible to use simple automatic apparatus to carry out the process.

(2) Due to the fact that the bottom end of the shell is open, the disc cover can be introduced into shell with the arched end first, which enables the making of a very tight fit between the shell and the disc. The tighter tamping of the primary loading (the fulminate), made possible in this way, results in the fulminate of mercury requiring no admixture of chlorate. Hence, the loading is simpler and the danger of explosion is lessened. The absence of the chlorate, moreover, causes a more powerful detonation to take place in the cap. This corresponds to the fact that pure fulminate of mercury $\text{Hg}(\text{CON})_2$, is much more difficult to de-

charge in the detonator and never on the primary charge. Furthermore, the danger of explosion is decreased by the absence of any deposits of explosive dust. The primary charge (fulminate of mercury) is placed within the detonator first and directly on top of it, the principal charge (TNT or tetryl). In this manner the primary charge covers the loading ladle with a coating of dust, which is removed afterwards by the principal charge, which, as has been mentioned previously, is insensitive and not dangerous in any way.

(4) Freedom from dust deposits makes it unnecessary to roll the loaded detonators in sawdust. It is, therefore, possible to load the detonators, after the charge has been placed in them, directly into the shipping cases. This is done by means of a simple automatic apparatus.*

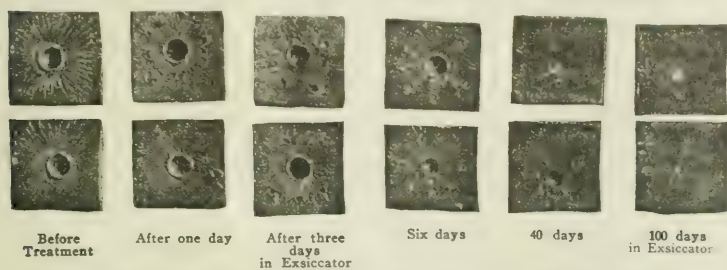


Fig. 8. Ordinary Detonators (Fulminate of Mercury and Potassium Chlorate).

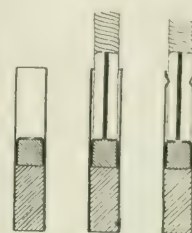


Fig. 10. Fuse Must Be Cut Straight and Placed Close to Safety Disc.

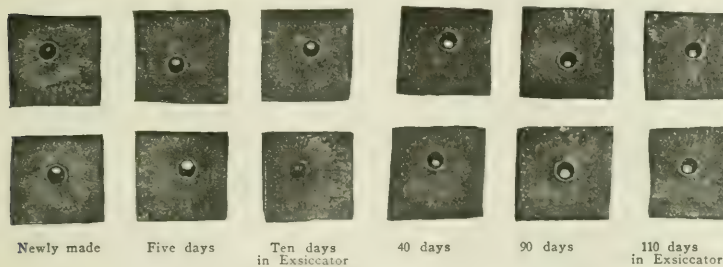


Fig. 9. Bofors Detonators, Showing Effect of Exposure in Exsiccator.

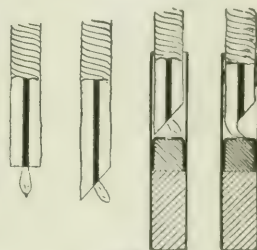


Fig. 11. Fuse Must Not Be Cut Obliquely.

nate than when it is incorporated with potassium chlorate. But when it does detonate, its explosive power is much greater than that of the chlorate fulminate composition. Due to the ability to tamp down the primary charge of the Bofors detonator, it is possible to omit the chlorate and use only 0.28 grams of fulminate of mercury, as in the No. 6 cap.

(3) The danger of explosion, while the cap is being made, is also reduced by the absence of the chlorate, as the pressure is applied always on the principal

charge in the detonator and never on the primary charge. Furthermore, the danger of explosion is decreased by the absence of any deposits of explosive dust. The primary charge (fulminate of mercury) is placed within the detonator first and directly on top of it, the principal charge (TNT or tetryl). In this manner the primary charge covers the loading ladle with a coating of dust, which is removed afterwards by the principal charge, which, as has been mentioned previously, is insensitive and not dangerous in any way.

Another point to be made here is that the bottom of the charge in the cap should be as close to the end of the shell as possible. Otherwise, there would be an air cushion interposed between the detonating explosive in the cap and the dynamite itself. This would deaden the effectiveness of the detonation. It is a matter for actual experimentation to determine whether the cap with a closed end (American practice) is more effective than one with an open end (Swedish practice), all other conditions being equal. It is our opinion that the open-end shell would prove more effective, but this is a matter of mere conjecture which can be proven by a practical test only. (Trans.)

It is surprising that no mention is made in this article as to the firing of the caps by means of an electrical discharge (the electric blasting cap). Just how these caps would work, when fired in this way would be very interesting to know. (Trans.)

*Nothing is said about the success of these fulminate TNT caps in the field. About three or four years ago, an attempt was made to introduce the use of a fulminate TNT detonator in the United States for mining and blasting operations. The caps failed badly. They did not give satisfaction at all, as very frequently they refused to fire. The trouble lay with the TNT which was not of sufficiently high purity. It was found that the TNT contained lower nitration products of toluene, such as DNT (dinitrotoluene). The DNT oozed out of the TNT and contaminated the fulminate which would not then fire, either when a fuse or an electric discharge was used. Since then, no further attempts have been made to manufacture such detonators. It is of course possible to obtain TNT of such purity that no fear need be felt of the caps not detonating.

As TNT is much cheaper than fulminate of mercury, the compound detonator possesses a decided advantage over the straight fulminate cap as regards cost. Furthermore,

The Maltose Syrup Situation

By George Defren

Consulting Chemist

MALTOSE syrup became a commercial product about a year ago.

It is made from starch by the action of diastase. Glucose, also known as corn syrup, is likewise made from starch, but acid is the hydrolysing agent.

Assigning to granulated sugar a sweetening value of 100, maltose syrup would rank about 50, while glucose would measure only about 20.

Last winter and this spring, when sugar was selling at from 20 to 30 cents or higher—when obtainable—maltose syrup was quoted at \$7 to \$10 per 100 lbs.

Not only was there an acute shortage of sugar, but glucose also was scarce.

Maltose syrup appeared at this stage and helped out. Officials of the Bureau of Chemistry quickly took up the new syrup, and through the public press heralded its virtues, based on laboratory samples submitted. These were often clear, water-white in color and almost honey-like in flavor. Many carloads were sold basis samples, but deliveries rarely came up to specifications. The product generally was dark, often turbid, and possessing more or less of the characteristic malt odor and flavor, which became more pronounced on storage.

The extensive publicity given maltose syrup caused many breweries, malt houses and corn goods concerns, all desperate for some opportunity to utilize their plants, to convert them into malt syrup factories.

Their managements rarely had the technical ability, efficient equipment or suitable locations for the purposes required, the outcome being in many cases sad experiences and worse.

Maltose syrups today are satisfactory for bakers' use, some types of preserves, beer—including home brews—some branches of candy manufacture, such as caramels, nougats, kisses, pastes, marshmallows, etc. Many maltose syrups had too much color or malt taste to make them satisfactory for the production of cream fondants for the high class candy trade. If the malt odor and taste be eliminated, maltose syrup can replace glucose for every purpose.

Maltose syrup has been satisfactory for ice cream production, and the outlook in this direction is excellent, as the ice cream produced is smooth, and will not granulate as ordinary sugar often does in this product. Its use in beverages, like ginger ales, etc., has been a failure to date, as the malt odor and taste mar the ginger or other delicate flavor. In this case also, the elimination of the malt odor and taste would make its use almost universal in the beverage trade, replacing granulated sugar.

Manufacturers of maltose syrup, being new in the art, were unable to instruct intelligently prospective users of the syrup, who used it in the same manner as glucose. Experience has shown that in some types of candy manufacture it should be handled differently than glucose. Some people using the new syrup have consequently been very much dissatisfied therewith.

The industry is going through practically the same stages as was done by glucose years ago. Maltose syrup has come to stay. In powdered form it will have even greater use than as a syrup. As the dried material is very hygroscopic, intelligence must be exercised in handling it.

Sugar has declined in price from around 30 cents to 11 cents today, and is going even lower, as the law of

supply and demand seems to be working again. An overproduction of granulated sugar in the near future seems certain.

The argument of saving money by using maltose syrup in place of granulated sugar has been the main talking point since its introduction. It does no longer hold. In other words, maltose syrup is to become a competitor of glucose and not of granulated sugar in price.

The great decline in the price of cereals has caused glucose, or corn syrup, made therefrom to follow suit. New competition attracted by the wonderful financial showings made during the war, is already manifest, and a slashing of prices is near at hand.

This competition will be a serious factor. The corn syrup market is well entrenched, standardized and efficiently handled. Consumers know how to use the article. Manufacture is carried out on an immense scale, with liberal financial backing, plants being generally located near the corn belt, or with otherwise convenient access to supplies of corn, and all of the by-products have been investigated thoroughly and utilized.

What chance has a little plant against such odds?

Maltose syrup is destined to supplant glucose in many lines, because, intrinsically, it is a better article.

It seems rather evident that maltose syrup hereafter must be better refined than formerly. It must be clear, nearly water white, free from malt odor and taste. It should sell at about the same price as glucose. This means large scale production under scientific supervision, just as is practiced in corn syrup manufacture.

Any plant which cannot measure up to these specifications has a serious problem ahead.

The Linde Air Products Co., M. E. Johnston, secretary-treasurer, 30 East 42d street, New York, will build at New Orleans, La., a 1-story 125 x 125 ft. plant for the manufacture of oxygen. S. R. Donnellon, 30 East 42d street, New York, is construction engineer. Plans call for an investment of \$250,000.

* * *

The Peerless Carbon Co. will spend \$100,000 in the construction of additional carbon black producing equipment at Guthrie, Okla.

* * *

T. H. Clarkson, of Buffalo, N. Y., has been appointed New York representative of the Clarkson Glue Company, an Illinois corporation, with a capitalization of \$400,000.

* * *

Dr. Henry H. Rusby, dean, College of Pharmacy, Columbia University, early next year will head a scientific expedition, financed by H. K. Mulford Co., Phila., Pa., in search of new drugs and narcotics in the Amazon basin, adjacent to Ecuador and Peru. Among the scientists accompanying Dr. Rusby will be Prof. Edward Kremers, volatile oils, University of Wisconsin and Augustus H. Gill, fixed oils, Mass. Institute of Technology.

* * *

E. H. Chapin, chemical engineer, University of Penn., 1920, has been transferred from the chemical division of the Ivorydale plant of the Procter and Gamble Co. to the Port Ivory, Staten Island, plant.

The Standardization of Colors

By Margaret Hayden Rorke

Managing Director, The Textile Color Card Association of the United States, Inc.

IN the narrative of the attainments of American chemical and commercial enterprise in the establishment of an independent dyestuffs industry, we must not overlook the important accomplishment represented by The Textile Color Card Association of the U. S., Inc. This is a trade association of wide and representative membership in all branches of American industry whose products are associated with the application of dyestuffs; hence the Color Card Association represents the dyestuffs-consuming interests, with membership embracing as well the producers of dyestuffs.

In tracing the evolution of the textile art, color has always been one of the biggest factors in its development. This likewise is true of many other allied industries. Progress has brought about an ever-increasing demand for color, with its multitudinous tints and shades which all have come under the spell of fashion. Some medium of color dissemination for many years has been vitally necessary for the textile producers' guidance. Europe long ago developed a system of color cards which forecasted Fashion's color taste. These were used by her textile manufacturers as a source of color inspiration. In spite of the fact that America had developed a great textile industry, she always had depended upon these European cards for her color inspiration.

How dependent the industry was upon these foreign cards was proven at the outbreak of the war, when the cards failed to arrive at the usual time, thus delaying the production of fabrics and causing loss.

It was then that the textile manufacturer awakened to the fact that an American color card was imperative. Enterprising men in the various branches of the silk, wool, cotton and millinery trades willingly gave their support and energy to the promoting of an organization which would act as a national source of color information, having as a medium of interpretation American Color Cards. Thus the Textile Color Card Association was founded.

It was recognized that there was an urgent need for color standardization; for a universal definition of the colors used in the textile trades, in order to establish a comprehensive understanding between the dyer, manufacturer and retailer. As the medium of this movement the association created the Standard Color Card of America.

This card is a collection of 133 colors, well recognized as being staples, and selected to meet the color needs of all industries. The colors are shown in silk and each color has been given a name and number equally

unchangeable. The number system adopted illustrates the relative proportion of the component parts of the color and can be identified by all related industries and trades. There is also a cable number to each color, thus making it possible to cable from any part of the world the color of the merchandise desired, eliminating the delay of sample sending, or the extra expense of lengthy color explanation. The advantages of this to the exporting trade is obvious.

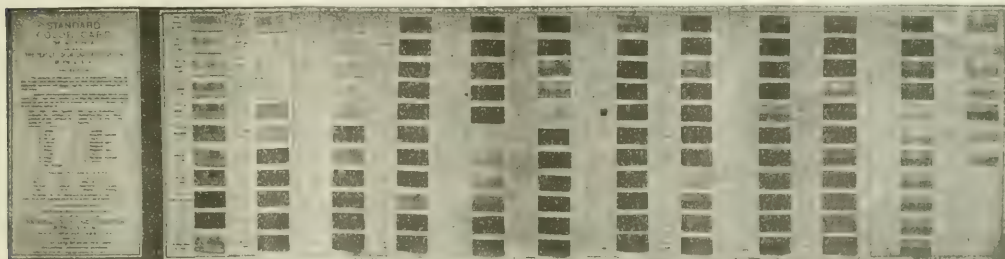
Aside from the establishing of the Standard Card, the Association has instituted a method of color service through the Season Cards, which it issues each spring and fall in order to offer the American producer and student of fashion a collection of colors, mostly novel in character, and adaptable from all angles to the needs of fashion.

And so through the initial efforts made by the textile industry five years ago, in answer to an urgent need, there has been fostered this movement of color standardization which has grown with such impetus that today its influence is reaching out into all industries.

Treating color standardization as an educational movement the Association has built constructively and in logical sequence. Starting with the manufacturer and through him to the dyer and dye-stuff producer, and then back to the retailer, the work has been carried on step by step until today the American Color Cards are used by every branch of industry interested in color. They have a distribution covering every state of the union and have crossed the seas to many foreign countries as far distant as China, Japan, India and Africa. As an industrial factor they have become so essential that there is scarcely any branch of industry that has not endorsed and adopted them through the official recognition of its trade association.

Also illustrative of the sound principle upon which the movement for color standardization is founded, the cards are being used by many of our leading schools and colleges wherein textile manufacture, industrial chemistry and domestic arts and sciences are taught. The schools are recognizing the commercial value of standardized American colors and the benefit to the student of becoming familiar with the colors universally used by industry.

While it seems a far cry from coal tar to the gorgeous color of mi-lady's gown, it is this very transition that illustrates how intimately connected fashion and her colors are with the dye-stuff industry. No wonder then, that the Textile Color Card Association counts



Facsimile of the Standard Color Card of America.

among its many members the leading dyestuff producers of America, who are giving their support and co-operation in furthering the Association's work.

The American Cards now include shoe and leather colors, created in conjunction with the various associations representing the shoe and leather industries. In fact the card covers the color needs of a uniquely wide and varied field. Thus they have become of primary interest to the dyestuff producer who must supply this same wide and varied field of industry with the needed dyes in order that the dyer may turn, like The Genii of Aladdin's Lamp, the uncolored raw material into a thing of colored beauty.

The 1921 Spring Season Card, the latest issued by the Association, contains 66 silk and 12 woolen colors. Un-

der separate grouping are the 10 shoe and leather colors selected by the Joint Styles Committees of the Shoe and Leather Industries. While a few standard and past seasonal colors have been recalled in response to their continued popularity, by far the majority are shades newly created for the 1921 Spring Season.

Many beautiful, brilliant colors appear in ranges of blues, orchid tints, greens, orange yellows, rose shades and flaming reds. The card is well tempered, however, with soft browns, grays and Navy blues, as well as copper and rust shades which prevail in both the silk and woolen groups. Great care, as usual has been given to the naming of the colors. Artistic merit is paramount and the card assures the American woman of discriminating taste, fashionable colors of American creation.

Status of Fuel Briquetting in the United States

THE utilization of the great heaps of anthracite culm and bituminous stack, common in the hard and soft coal mining regions, by compressing these materials, with an adhesive, into a shape favorable to efficient combustion long has been proposed as a substantial addition to our fuel supplies and a real contribution to their conservation.

Encouragement to such utilization awaits upon such prices for the commercial sizes of these two varieties of coal as will warrant investment in the enterprise.

At the height of our war-time activity in 1918, with scarcity of fuel consequent upon decreased production, the briquetting of waste fuel found its maximum encouragement, with the result that in that year 477,235 net tons, valued at \$3,212,793, were produced, which was more than twice the production of 1915. In 1919, production of briquets fell off to 295,734 net tons, valued at \$2,301,054, which represents the present progress of the industry since 1907, when 66,524 net tons were produced.

After the armistice the country was found to be stocked with coal in excess of his peace-time requirements. Not only did the closing of munition plants reduce the industrial demand for fuel, but the unusually mild weather during the winter of 1918-19 curtailed the consumption of domestic fuel as well. In consequence the production of bituminous coal fell off 21 per cent. from 1918 to 1919, and that of anthracite 13 per cent. The depression in the briquet-making industry was due to essentially the same causes. As the demand for coal in general became less active, producers of briquets found increasing difficulty in meeting the competition of other forms of domestic fuel, particularly anthracite. It is significant of this competition that the production of anthracite, like that of briquets, fell back to the level of 1916.

In the accompanying table are shown the geographical distribution of the industry, character of material used and the operators in the industry:

The classification of the raw fuel used in briquet manufacture and the tonnage produced of each class for the past three statistical years are indicated below:

Tonnage and Kind of Raw Fuel Used for Briquets.

	1917 Net Tons	1918 Net Tons	1919 Net Tons
Anthracite culm and fine sizes	137,659	209,690	104,027
Semianthracite	161,269	180,714	111,955
Semibituminous			
Bituminous slack			
Lignite and subbituminous coal.			
Oil-gas residue	103,408	76,602	80,383
	402,336	467,006	296,365

Three of the 12 plants which operated in 1919 used no binder, 3 used asphaltic pitch, 2 coal-tar pitch, 1 coal-tar pitch and asphaltic, 1 asphaltic pitch and sulphite pitch, 1 sulphite liquor, and 1 a patent binder. Of the total quantity of briquets produced 17 per cent. was manufactured without binder, and 75 per cent. with a binder or either asphaltic pitch, coal-tar pitch, or a mixture of the two. The quantity produced with the use of other binders was 10 per cent. of the total.

Briquets produced in 1919 by type of binder used, in net tons.

No binder	49,324
Asphaltic pitch	103,970
Asphaltic pitch and coal-tar pitch	112,465
Coal-tar pitch	
Asphaltic pitch and sulphite pitch	29,975
Waste sulphite liquor	
Patent binder	
	295,734

Briquetting Plants Operated in the United States in 1919.

Group.	Location.	Date put in operation.	Raw fuel used.	Name and address of operator.
Eastern States:				
New Jersey	Trenton	1918	Anthracite	Fuel Briquet Co., 520 Brunswick Ave., Trenton, N. J.
Pennsylvania	Sunbury	1919	Anthracite	Anthracite Briquette Co., Sunbury, Pa.
Pennsylvania	Landsford	1909	Anthracite	Lehigh Coal & Nav. Co., 437 Chestnut St., Philadelphia, Pa.
Pennsylvania	Dickson City	1907	Anthracite	Seranton Anthracite Briquette Co., Dickson City, Pa.
Virginia	Parrott	1915	Anthracite	Deiparen Anthracite Briquette Co., 1 Bway, New York, N. Y.
Central States:				
Missouri	Kansas City	1900	Arkansas semianthracite.	Standard Briquet Fuel Co., 319 Fourth St. N., St. Louis, Mo.
North Dakota	Seranton	1917	Lignite	Johnson Fuel Co., Fairfax, S. Dak.
Wisconsin	Superior	1912	Semibituminous slack	Berwind Fuel Co., 122 Michigan Ave. S., Chicago, Ill.
Wisconsin	Superior	1909	Anthracite culm and bituminous slack	Stott Briquet Co., Merchants Natl. Bk. Bldg., St. Paul, Minn.
Pacific Coast States:				
California	Los Angeles	1905	Carbon (petroleum residue).	Los Angeles Gas & Electric Corporation, 645 Hill St. S.
Oregon	Linnton	1913	Carbon (petroleum residue).	Los Angeles, Calif.
Washington	Renton	1914	Bituminous slack and sub-Portland Gas & Coke Co.	294 Yamhill St., Portland, Oreg.
			bituminous coal.	Pacific Coast Coal Co., 612 L. C. Smith Bldg., Seattle, Wash.

a Plant destroyed by fire in 1909; reconstructed in 1911.

Limestone and Its Products in the Chemical Industries

LIMESTONE, one of our commonest rocks, is of sedimentary origin, having been deposited from solution by living organisms, or by chemical and physical processes not related to changes in living matter.

Limestone is never found pure. Its impurities, chiefly magnesia, iron, alumina and silica, and its physical properties, determine not only its classification, but that of its products, viz., quicklime and hydrated lime, the former being limestone with its carbon dioxide removed by heat, the latter being quicklime to which has been added sufficient water to insure complete hydration (slaking) under such conditions that the heat generated will evaporate the excess water, leaving the product dry and, after screening to various commercial degrees of coarseness, available for use for any purpose for which quicklime is suitable. The advantages associated with its use more than counterbalance the freight on the contained water arising from hydration.

Classification—Limestone

Calcite is very pure crystallized limestone. As the magnesia (MgO) content increases, the stone is called magnesian limestone until the ratio of calcium carbonate ($CaCO_3$) to magnesium carbonate ($MgCO_3$) becomes 100 to 84 when it is termed "dolomite." With magnesia content low and other impurities increasing, the rock is known as argillaceous (clayey) limestone, natural cement rock, suitable for Portland cement manufacture, and calcareous shale. Marble is limestone metamorphosed by heat.

Classification—Lime

High calcium: Not less than 90 per cent. calcium oxide, CaO .

Calcium: Not less than 85 per cent. nor more than 90 per cent. CaO .

Magnesian: Not less than 10 per cent. nor more than 25 per cent. magnesium oxide, MgO .

High Magnesian: Not less than 25 per cent. MgO .

The total amount of impurities, exclusive of CO_2 , should not exceed 5 per cent. in selected lime, or $7\frac{1}{2}$ per cent. in run-of-kiln lime. According to availability for use, lime may be classified as building, finishing, chemical or agricultural lime.

Use of Limestone, Lime and Hydrated Lime in the Chemical Industries

In many branches of chemical manufacture limestone, lime and hydrated lime are used interchangeably, the value residing in the CaO content. Hydrated lime should contain less impurities than the lime from which it is made; also it keeps better and is easier to handle than lump lime. When lime is used in a hydrated condition, unless the heat of slaking is utilized, hydrated lime is more economical.

Natural Cements

These cements, whether made from rock or from blast furnace slag, are much more acid in character than Portland cement. The addition of lime by increasing the basicity, increases the strength, E.G., addition of 5 per cent. lime to some natural cements increases the tensile strength from 100-200 per cent. A hydrated high calcium lime must be used. Magnesia is objectionable because it is apt to carbonate after the cement has set, which weakens it. Other impurities are of little

importance. Addition during grinding of the cement insures intimate admixture.

Sand-Lime Brick

Sand-lime brick, although a rather new material, is of some importance in the building industry. The process of manufacture consists in forming bricks of a mixture of sand and hydrated lime by means of pressure. The bricks are then treated with high-pressure steam, which causes chemical combination between the sand and lime. The lime may be hydrated before or after adding the sand, but hydration must be complete before the bricks are pressed in order to prevent any further change of volume.

High-calcium lime must be used. Any large amount of magnesia is dangerous, because it will probably not be hydrated until after the brick is pressed into shape. The steam treatment will hydrate the magnesia, which will expand and either weaken or completely disintegrate the brick. The impurities generally present are not harmful, except in so far as they may cause the lime to slake more slowly. In fact, kaolin, up to $2\frac{1}{2}$ per cent., may be considered beneficial. Hydrated lime is to be preferred to quicklime because it is more easily mixed with the sand. This statement is made on the assumption that the hydrated lime is perfectly and completely hydrated. Most sand-lime brick manufacturers prefer to buy quicklime and hydrate it themselves, because they must be absolutely certain that the hydration is complete.

Glass

Calcium oxide is a necessary constituent of plate, sheet and bottle glass, and of a large portion of pressed and blown glass. It acts as a flux. Magnesia makes the glass more difficult to melt, but is sometimes a valuable constituent when particular optical properties are to be obtained.

The calcium oxide is generally introduced as ground limestone, but in this industry also, the use of lime or hydrated lime is sometimes necessary in order to avoid the evolution of gas at high temperatures. The ordinary impurities of limestone are, in general, of no importance to the glass manufacturer. For white glass, however, the content of oxide of iron must be less than three-tenths of 1 per cent. of the stone.

Lime used in glass factories in 1918 amounted to 34,051 tons, valued at \$265,855. This represented 1.1 per cent. of the total lime produced.

Ceramics

Lime and magnesia, generally, however, as carbonates, are used to some extent as fluxes in the manufacture of pottery and porcelain. It has been found that for wares burned at moderate temperatures, calcium oxide tends to bring the points of vitrification and fusion close together, while magnesia tends to separate them, to lower the temperature of vitrification, and to decrease the change of shape due to burning.

On the other hand, if the ware is to be burned at higher temperatures, magnesia has little effect on the points of vitrification and fusion and increases shrinkage. In a series of experiments to determine the values of different bases when used as fluxes for a mixture of feldspar, flint and clay, it was found that magnesia gave the best results of the five bases tried (oxides of calcium, magnesium, barium, strontium and zinc). It

gave an excellent color, high tensile strength, and only moderate shrinkage.

The above results all indicate that magnesia is better than calcium oxide as a flux for ceramic bodies.

The carbonates are generally used, since they are the cheapest forms. Levigated natural whiting is preferred on account of high colloidal content. In some cases, however, vitrification sets in before the carbonates are all decomposed, and further evolution of gas may cause pinholing or internal strain. Under these circumstances it is necessary to use either the oxide or hydrate. It is sometimes desirable to use the carbonates in wares burned at low temperatures in order to obtain a porous body.

Since the quality of carbonate used is generally small, and the chemical composition of the mixture may vary slightly, it follows that the impurities generally found in limestones are entirely negligible.

In glazes, magnesium oxide tends to absorb SO_3 from the kiln gases with production of a scum appearance. Although this can be overcome by skillful firing, it makes a low magnesia content desirable in most glazes.

Water Purification

Temporary hardness of water is caused by the presence of calcium carbonate. This substance is practically insoluble in pure water, but is held in solution by the presence of carbon dioxide, which is found in practically all natural water. If this carbon dioxide is removed, the calcium carbonate will be thrown out of solution. The carbonic acid may be removed by boiling, but it is cheaper to neutralize it with lime. The lime reacts with the carbon dioxide to form calcium carbonate, and, since the carbon dioxide is thus removed, this calcium carbonate, together with that originally present, will be thrown down as an insoluble precipitate. While any magnesium carbonate present in the water will be removed by the same process, the magnesium oxide in the lime will take no part in the reaction and must be considered as an impurity.

The lime to be used should contain as much calcium oxide as possible. The generation of heat on slaking is of advantage in this process, for the reaction takes place more efficiently at elevated temperatures. Therefore the quantity of impurities should be low, and the use of hydrated lime is not advisable.

Soda Ash and Caustic Soda

Most of the soda ash sold in this country is made by the ammonia-soda (Solvay) process, which is based upon the precipitation of sodium bi-carbonate from an ammoniacal solution of common salt by means of carbon dioxide. Ammonia appears in the form of the chloride from which it is recovered by treatment with lime and distillation.

This industry demands limestone, for both the lime and the carbon dioxide are used. The impurities in the stone are not harmful. It would seem that magnesium oxide should be as effective as calcium oxide in breaking up the compounds of ammonia, yet Lunge¹ makes the statement that "magnesium limestone is not suitable for this industry."

Solutions of caustic soda, which are used in the purification of cotton, rags and wood pulp in the manufacture of paper and explosives, are made by causticizing soda ash with lime. The reaction produces insoluble calcium carbonate, which settles to the bottom of the tank, and

caustic soda remains in solution. The lime for this purpose should be as pure and as high in calcium as possible. Magnesia and other impurities are objectionable because they are slow in settling out after the reaction is completed. This results either in contamination of the soda or in a decrease in the daily output of the plant. In this industry quicklime is preferable to hydrated lime because it hastens the reaction.

Bleaching Powder

Bleaching powder is an oxychloride of calcium which is formed by the action of chlorine gas on moist slaked lime. The resultant product is sold on the basis of available chlorine. Any impurities in the lime will lower the amount of chlorine absorbed and consequently the value of the product. Magnesia is especially objectionable because it forms magnesium chloride.² This substance absorbs water from the air and makes the powder sticky and hard to handle.

Hydrated lime is better suited for this industry than quicklime, because it contains fewer impurities, is easier to handle and requires no preparation before using.

Calcium Carbide

This substance, used as a source of acetylene, is made by heating a mixture of lime and coke in an electric furnace. For this purpose the only useful ingredient of the lime is calcium oxide. Magnesia and other impurities are objectionable because the whole charge must be fused, and electric power is too expensive to waste it by heating useless material. For the same reason quicklime is preferable to either hydrated lime or limestone.

Illuminating Gas and Ammonia

When illuminating gas is made by the distillation of coal the crude product contains, among other compounds, carbon dioxide, hydrogen sulphide and hydrocyanic acid. All of these would be objectionable to the consumer. Their removal may be effected by passing the gas through layers of moist slaked lime. For this purpose calcium oxide only is useful, although the magnesia and impurities are not harmful. Hydrated lime is to be preferred to quicklime because it is easier to handle and requires no preparation.

Calcium Cyanamid and Calcium Nitrate

These substances, known technically as lime nitrogen and nitrate lime, have recently been put on the market as commercial fertilizers. They represent means of converting the nitrogen of the air into plant food.

Calcium cyanamid is prepared by heating a mixture of lime and coke in an electric arc furnace and treating the fused mass of calcium carbide with nitrogen. The nitrogen is obtained by the fractional distillation of liquid air. Pure, high-calcium quicklime is required for this industry. Any impurities are undesirable on account of the expense required to heat them.

If air is passed through an electric arc, the nitrogen and oxygen contained in it will combine. The oxides of nitrogen thus formed, when dissolved in water, produce nitric acid, which may be combined with any base to form the corresponding nitrate. Since lime is the cheapest of all bases, and has fertilizing value of its own, it is obviously the best base to use. Hence calcium nitrate is produced commercially by this method. Magnesia acts in a similar manner. The presence of impurities in the lime is a matter of indifference, and quicklime, hydrated lime or limestone will produce identical results. Hydrated lime is probably the most economical.

¹Lunge, *Sulphuric Acid and Alkali*, 3, p. 37.

²Lunge, *Sulphuric Acid and Alkali*, 3, p. 440.

Fertilizer

Lime is used extensively as a fertilizer. The Department of Agriculture and the various state agricultural experiment stations have investigated the use of lime for this purpose and have published their conclusions in numerous bulletins.

A correlation of these results will lead to the following general statements:

(1) A plot of ground is in need of lime when it fails to produce a good crop of common red clover, or when the clover crop contains patches of sorrel.

(2) Lime should never be used alone, but always in connection with some organic fertilizer.

(3) Care must be taken not to use too much lime, as this will tend to waste the plant food stored in the soil. If the lime is coarsely ground more must be used, but its effect will be more lasting.

(4) Magnesia is at least equally as valuable as lime for use as a fertilizer.

(5) Whether the lime should be applied as ground quicklime, hydrated lime, air-slaked lime or ground limestone depends chiefly on the cost per unit of calcium oxide (it being assumed that the four substances are of the same fineness). Thus 500 pounds of ground quicklime, which is the quantity recommended for one acre, are equivalent to 950 pounds of hydrated lime or 1,250 pounds of either ground limestone or air-slaked lime.

(6) Lime is sometimes used to improve the drainage conditions in the soil, and for this purpose ground quicklime alone is suitable.

Spraying

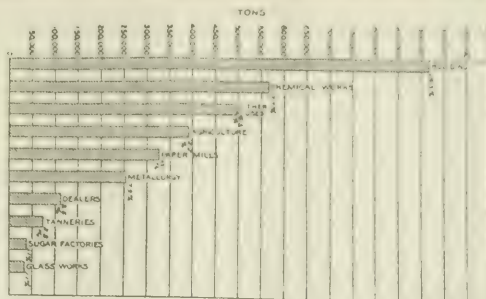
Lime enters into the preparation of a number of insecticides used in spraying vegetation. For such purpose calcium oxide is the only useful constituent of the lime. Magnesia and impurities are not harmful. The physical quality of the lime is of paramount importance. The material is sprayed on the vegetation through some form of atomizer, and therefore must contain no coarse particles or grit. For this reason hydrated lime screened to pass 150 or 200 mesh (a commercial article) would certainly give better satisfaction than lump lime.

Sugar

In the manufacture of sugar both carbon dioxide and lime are used. Therefore, sugar manufacturers prefer to buy limestone and burn their own lime.

The juice extracted from either beet or sugar cane contains various impurities. Some of these would discolor the sugar and others (organic acids) would invert it; that is, they would change the sugar into uncrystallizable glucose, and thus reduce the yield. In order to remove these impurities the juice is heated almost to boiling in the presence of an excess of lime. This combines with the acids and breaks up the other organic compounds forming insoluble salts, but it also forms an insoluble compound with the sugar itself. For this reason, after the lime has completed its action, carbon dioxide is forced into the liquid. This breaks up the combination between the lime and sugar and throws down all the lime as calcium carbonate. This precipitate carries with it all suspended matter, leaving a clear solution of sugar.

For the above purposes calcium oxide only is useful. Impurities are apt to cause trouble. Thus, magnesium carbonate is more soluble in sugar solutions than calcium carbonate, and the salt so dissolved is later deposited on the tubes in the evaporating pans, thus making it necessary to clean them more frequently. Any silica present is thrown down as a gelatinous precipitate. This becomes a general nuisance by coating the cloth in the filter presses.



Production of Lime for Specified Uses in 1918.

Limestone and Lime Used by Sugar Factories in Refining, 1916-1918.

	1916		1917		1918	
	Quantity (short tons)	Value	Quantity (short tons)	Value	Quantity (short tons)	Value
Limestone	369,028	\$369,694	530,612	\$666,138	435,555	\$649,589
Lime	21,923	118,572	47,546	381,746	36,494	314,748
Total		\$488,266		\$1,047,884		\$964,337

Distillation of Wood

The destructive distillation of wood gives rise to four products: gas, pyroligneous acid, tar and charcoal. Of these, pyroligneous acid is of most interest to the lime manufacturer. From this solution are prepared wood alcohol, acetic acid and acetone, and lime is an essential ingredient in the manufacture of all of these. First, the crude acid is treated with an excess of lime and distilled. Wood alcohol passes over. The material remaining in the still is known as gray acetate of lime. From this, acetone may be produced by dry distillation, or it may be treated with sulphuric acid and the acetic acid distilled off. The wood alcohol is again treated with lime and redistilled in order to purify it.

For any of the above purposes calcium oxide is the only useful constituent of the lime. Magnesia and impurities are not harmful. Hydrated lime may be used instead of quicklime for any of the above purposes except the final distillation of the wood alcohol. For the other purposes probably neither substance has any advantage over the other.

Paper

Wood pulp for the manufacture of paper is prepared by one of four processes: Mechanical, soda, sulphite or sulphate, of which only the last three interest the lime manufacturer.

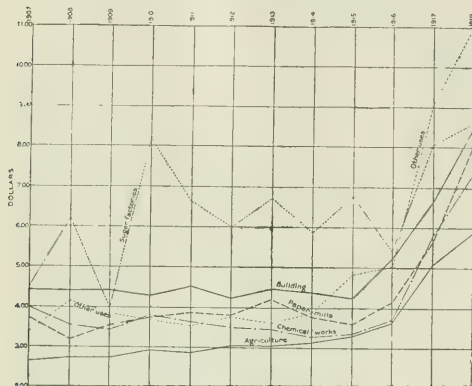
In the soda process lime is used to causticize sodium carbonate, thus recovering the caustic soda used in cooking the wood. The quality of lime required for this purpose was discussed under "Soda Ash."

Lime Used in Paper Manufacture, 1917 and 1918

Process	Short tons	Value	Short tons	Value
Soda	171,865	\$994,417	149,443	\$1,229,579
Sulphite	77,020	422,026	88,631	726,610
Sulphate	28,154	172,635	34,515	260,722
Strawboard	9,918	55,149	19,688	146,335
Rag	(a)		14,649	115,283
Unspecified	68,811	364,206	18,876	132,112
Total	355,768	\$2,008,433	325,172	\$2,610,645

Another solution which may be used in place of caustic soda for dissolving the cementing constituents of wood is bisulphite liquor. This is a mixture of calcium

and magnesium bisulphites held in solution by an excess of sulphur dioxide. The liquor is prepared by one of two methods: Limestone may be subjected to the solvent action of sulphur dioxide and water; or milk of lime may be treated with sulphur dioxide. The resultant solution is the same in either case.



Average Price Per Ton of Lime for Different Uses, 1907-1918.

For the maker of sulphite pulp magnesia is a desirable constituent of the lime or limestone. Magnesium sulphite is more soluble than calcium sulphite, and consequently permits of making a stronger liquor. Moreover, the presence of magnesia in the liquor gives the pulp a better color and makes it softer to the touch, so that it will felt together better when made into paper. Therefore, dolomite, or magnesian lime, is much preferable to the high-calcium compound. The impurities are not harmful. If limestone is used it should be as porous as possible to permit of rapid solution. Hydrated lime is preferable to lump lime, because it is easier to handle and contains fewer impurities.

Paints

Ground lime, air-slaked lime, levigated chalk (natural whiting) and chemically precipitated calcium carbonate are used to a large extent in the paint and allied industries. For these purposes fineness of grain is essential, while sometimes the color or chemical composition is of equal importance. It is generally impossible to obtain a limestone of sufficient whiteness, or to grind it sufficiently fine to meet the requirements. It is therefore an advantage to use air-slaked lime or hydrated lime.

Tanning

In the leather industry lime is used in the depilation process. The hair is so loosened from the hide by soaking it in lime water that it can be removed by subsequent scraping. In regard to the quality of lime to be used it is said that the presence of magnesia and clay is injurious, not only by diminishing the amount of lime present, but by making the lime much more difficult to slake; and iron oxide, though quite insoluble, may become mechanically fixed in the grain of the hide, and may be the cause of subsequent stains. The use of hydrated lime would remove the above objections to magnesia, but not those to iron. Hydrated lime is probably preferable to quicklime for this reason and because it is easier to handle.

Lime used by tanneries in 1918 amounted to 74,350 tons, the largest amount ever reported, valued at \$637,960—an increase in quantity of 12 per cent. and in value of 56 per cent., compared with 1917.

Tonnage of Lime Used in Production of Chemicals

The latest available statistics (1918) show that for that year 26 per cent. of the chemical lime was used in alkali manufacture. Calcium carbide manufacture consumed 15 per cent.; acid manufacture 7 per cent.; bleaching 7 per cent.

Lime Sold to Chemical manufacturers in 1918.

Use	Quantity (short tons)	Value
Alkali works.....	145,031	\$768,570
Potash salts.....	176	1,409
Ammonia works.....	13,975	99,831
Explosives (kind unspecified).....	23,735	173,129
Nitrates and glycerine.....	2,059	12,468
Gun cotton preparation and gelatin.....	10,755	88,784
Acids.....	38,388	298,660
Cyaniding.....	12,512	118,274
Calcium carbide.....	87,434	785,912
Alcohol:		
Dehydration and manufacture of.....	1,535	10,638
Wood distillation.....	13,986	121,678
Bleaching works.....	37,905	306,726
Phenol.....	25,002	196,463
Salt refining.....	1,791	13,388
Coal and water gas purification.....	171	1,959
Coke-oven by-products.....	23,451	174,437
Gas-plant by-products.....	2,371	19,309
Undistributed*.....	4,481	32,966
Unspecified.....	120,774	952,701
	566,532	\$4,177,302

* Includes lime sold for use in manufacture of calcium acetate, aluminum hydrate, barium products and precipitated calcium carbonate.

Lime Sold for "Other Uses" in 1918.

Use	Quantity (short tons)	Value
Refractories.....	318,896	\$4,097,819
Silica brick.....	26,517	182,659
Sand-lime brick.....	7,417	59,357
Soap.....	29,599	202,028
Lubricating grease, renovating of butter, etc.....	3,395	202,410
Kalsomine.....	999	9,076
Water purification and softening.....	75,448	596,667
Sewage purification and neutralization of acid water.....	9,514	68,668
Disinfectants.....	6,059	51,438
Glue manufacture.....	8,822	78,599
Pottery and porcelain manufacture.....	129	1,213
Polishing and buffing compounds.....	384	4,424
Cotton, thread and woolen mills.....	2,117	21,425
Flour mills.....	164	1,785
Spraying.....	1,813	16,706
Undistributed*.....	7,790	56,621
	499,063	\$5,476,895

* Includes small quantities of lime reported as sold for manufacture of candles, corn products, dyes, rubber, proprietary medicines, varnish, graphite, for refining gold and platinum, for use in slag cement, in print works, tobacco factories, copper and file works, for sheep dip, and other uses not specified.

The Boonton Rubber Mfg. Co., manufacturer of molded rubber products, etc., Boonton, N. J., has increased its capital from \$225,000 to \$600,000.

* * *

The D. B. Martin Co., manufacturers of industrial fats and oils and fertilizers with plants at Philadelphia, Pa., Wilmington, Del., and Baltimore, Md., has been purchased by Wilson & Co., Chicago, which will operate the business as the Wilson-Martin Co., under the management of W. W. Bowers, formerly a general superintendent of Wilson & Co., who has been advanced to a vice-presidency.

Chemists, Trade Secrets and Employment Contracts

ONE of the questions which is always considered by the chemist and the concern with which he is connected is that of the extent to which the chemist may use the knowledge and experience he has acquired, when he leaves his employment. This becomes particularly important where, and it arises in many instances, the employer claims that his product is the result of certain trade secrets or secret processes.

George A. Chritten, a member of the law firm of Dyrenforth, Lee, Chritten & Wiles of Chicago, in a contribution to *The Chemical Bulletin* of the Chicago Section of the American Chemical Society, sets forth briefly the facts and circumstances of the recent litigation between the Dow Chemical Company and a former employe and the company organized to exploit the invention and skill resulting from his experience acquired initially with the Dow Chemical Company

The Case

In *Dow Chemical Company vs. American Bromine Company* and *Arthur E. Schaefer*, the Dow Chemical Company obtained an injunction in the lower court of Detroit, Michigan, against the two defendants, restraining them from using certain alleged secret processes relating to the manufacture of bromine and bromine compounds, and a decree directing Mr. Schaefer to assign to the plaintiff corporation a patent for an invention made by Mr. Schaefer. The case was appealed by the defendants to the Supreme Court of Michigan, which, on June 7, 1920, reversed the trial court and dismissed the bill of complaint at the cost of the plaintiff in both the trial court and the Supreme Court (210 Michigan Sup. Rep. 262).

The Facts

The Dow Chemical Company for about thirty years has been engaged in the manufacture of chemicals, and has been manufacturing bromine and bromine compounds for several years. Mr. Schaefer went with the Dow company in 1904, direct from college, and in 1905 he was put in charge of the bromide plant. Later he was away from his employment for a time, but returned in 1908, when he was made superintendent of the bromide plant, leaving the Dow company in July, 1910.

Mr. Schaefer signed a contract with the Dow company providing—

"that all inventions and discoveries, pertaining to the manufacture of bromides, bleaching powder or bensoates, which may be made by him while in its employ, shall become the property of said company," etc.,

the contract further requiring him to assign all applications or patents relating to such inventions to the company without further compensation, and also requiring him to disclose promptly any such invention so conceived by him, and to make the necessary applications for patents thereon, the contract being similar in terms to that which all other technical employees were required to sign by the Dow company as a condition of their employment.

On December 14, 1911 (about a year and a half after severing his connection with the Dow company), Mr. Schaefer filed an application relating to the absorption step in the process of manufacturing bromine, and the patent issued on such application on February 3, 1914. The Dow company equipped its plant for operation under the Schaefer patent, having obtained a license to use the invention from Mr. Schaefer. A number of

patents, some seventeen in all, had been taken out by the Dow company, relating to the production of bromine, some of which had expired. While employed by the Dow company, Mr. Schaefer had assisted Mr. Dow in working out some of these inventions; indeed, he was a co-inventor with Mr. Dow in several of them.

The defendant corporation was organized by certain stockholders of the Emerson Drug Company, and of the Dr. Miles Medical Company, both of these companies being large users of bromine. In 1914, bromine was selling at somewhat less than 50 cents per pound, but by 1916 it had gone up so that bromide of potassium sold at \$5.50 and bromide of sodium at \$3.50 per pound; shortly after the defendant corporation began production, these prices went down to \$1.00 and 45 cents per pound, respectively, the Dow company claiming that the defendant company was responsible for this reduction.

As soon as the Dow company learned that the defendant company was preparing to engage in the manufacture of bromine, certain correspondence and conferences were had. Defendant company was advised to go carefully into the patent situation, which it had already done with great care, but nothing whatever was said, either in the conferences, or in the correspondence, about trade secrets or secret processes, nor was any objection made to the employment of Mr. Schaefer by the defendant corporation; indeed, nothing whatever was said about trade secrets until the complaint was filed, nor did the Dow company make any claim to the Schaefer patent until that time.

The Decision

The opinion of the Supreme Court, reversing the trial court, is thirty-three pages in length, and goes very fully into the facts and the authorities. It discusses the evidence as to trade secrets, which was conflicting, and after saying that the idea of secrecy appears not to have originated in Mr. Dow's mind until about the time the bill was filed, the court says:

"We are impressed that the claim of secrecy on the part of the plaintiff is an afterthought, indulged in, possibly, by reason of the fact that Mr. Dow felt relief through injunctive process from the Federal courts for infringement was doubtful. The situation presented by us in the 'Sticky Fly Paper' case (*O. & W. Thum Co. v. Tioczynski*, 114 Mich. 149—38 L. R. A. 200), and in the supporting cases there cited. In that case no effort had been made by the plaintiff to protect the invention by patent, but reliance for protection was placed solely upon secrecy. And, moreover, the court found no difficulty in determining that an express contract existed between plaintiff and defendant, by the terms of which defendant was bound not to disclose the secrets of the operation learned by him in the course of his employment. Our conclusions upon this branch of the case are fatal to the claims of the plaintiff."

The court further held that, as Mr. Dow had failed to disclose fully certain of his inventions, for which patents had been issued, apparently failing to make such disclosures for the express purpose of making it difficult for others to practice these inventions (in direct contravention of the patent statutes, which require a full and free disclosure), the plaintiff was not entitled to equitable relief, on the theory that *one who comes into equity must do equity and must come with clean hands*.

With respect to the ownership of the Schaefer patent, application for which had been filed by Mr.

Schaefer almost a year and a half after he left the employment of the Dow company, the opinion says:

"We are of the opinion that the Schaefer patent, under which the corporate defendant is now operating, was, as claimed by him, based upon investigation and invention subsequent to the termination of his employment by plaintiff. It is, therefore, not subject to the terms of the contract existing between him and the plaintiff during the latter years of his employment. If said patent is an infringement on any patent owned or controlled by plaintiff (as originally claimed by Mr. Dow), plaintiff has its remedy in the Federal courts for such infringement.

"Through the beneficial operation of the patent laws plaintiff has, for a great many years, enjoyed a practical monopoly in the production of bromides. That monopoly clothed it with power to exact an exorbitant price for its product, which power at times, the record discloses, it did not hesitate to exercise. As soon as defendant commenced quantity production of bromides, the price of the product in the open market dropped to a figure only about one-fifth that exacted by the plaintiff prior thereto.

"Upon broad equitable principles and in consideration of public policy, plaintiff should be denied relief unless its claim thereto is clearly established. After a careful consideration of this very voluminous record, we have no hesitation in reaching the conclusion that plaintiff has failed to so establish its right to relief."

Remarks

It will be noted that there is nothing revolutionary in the foregoing opinion, which we think is in accord with the authorities. Generally speaking, an employee is entitled to use, in the absence of an express contract to the contrary, in any subsequent employment, all the knowledge, skill and experience theretofore acquired by him. Nothing was said in the contract between the Dow company and Mr. Schaefer about not disclosing knowledge obtained by him as a result of his employment, and he was, therefore, under no contractual obligations of any sort.

Furthermore, we do not think the alleged trade secrets of the Dow company were such as to come within the authorities. The general rule is that to entitle the plaintiff to protection with respect to its so-called secrets, they must be secrets in facts, and not secrets merely because the plaintiff chooses to so designate them, or, as is stated in Section 19, p. 158, of Hopkins on Unfair Trade:

"In every case where the plaintiff seeks protection for a trade secret, it must appear that it really is a secret. If a so-called secret process is known to others in the trade, no one will be enjoined from disclosing or using it."

With respect to the claim made by the Dow company to the ownership of the Schaefer patent, there can be no question that the court was correct. The general rule, and very properly so, is that the employee, in the absence of an express contract to the contrary, is entitled to the inventions he makes, even though they relate to the subject-matter of his employment, subject usually to the right of the employer, if the inventions are made upon the time and at the expense of the employer, to use such inventions in his own business. Here the contract only required Mr. Schaefer to assign any inventions relating to the manufacture of bromine "which may be made by him while in its employ." Perhaps a fairer way to all concerned is to make such contracts apply to inventions made during the term of the employment and within two years after the termination of such employment.

While we have no reason to question Mr. Schaefer's statement that this particular invention was not made by him until after he left the employment of the Dow company, especially in view of the fact that the application was not filed until almost a year and a half thereafter, it not infrequently happens that a designing em-

ployee, with a contract limiting his obligation to assign to inventions made during the period of his employment, will conceive an invention while so employed, but will say nothing about it and quit. Within a short time afterward, perhaps, he files an application upon such invention, and then claims it was not conceived until after his employment relation terminated. We think the better plan is to have such contracts extend for two years after the employment relation has ceased, and also to provide for a consideration to be paid by the employer to the employee for each such invention so to be assigned.

Disclosures of Trade Secrets and Business Confidences

In this same connection it is of interest to note the opinion of Mr. Colin C. H. Fyffe, general counsel of the Illinois Manufacturing Association, on whether employees can disclose information of trade secrets and business confidences of a competitor, consisting of a list of customers and prospective customers. He says:

"I do not think that the Clayton Act has any bearing on employees betraying trade secrets belonging to their employers. The law on this point, however, is well settled. The rule is thus stated in 20 A. & E. Encyc. of Law (2d Ed.), sub-title Master and Servant, page 49.

"Where a person invents or discovers and keeps secret a process of manufacture, whether patentable or not, he has not an exclusive right to it as against the public or against those who in good faith acquire knowledge of it, but he has a property in it which a court of chancery will protect against one who in violation of contract undertakes to apply the process to his own use or discloses it to third persons."

Where there is an express agreement between employer and employee not to disclose trade secrets, a court of equity will grant an injunction against an employee doing so or for using the trade secrets for his own private use. The case is the same where one is taken into employment on an implied agreement not to use himself or to communicate to others such trade secrets. This implied agreement arises in all cases where confidential relation exists between employer and employee. See

Stone v. Goss, 55 Atl. (N. J., 1903) 736;

Harvey Co. v. National Drug Co., 77 N. Y. Supp. 674;

Thum Co. v. Tloczynski, 72 N. W. (Mich. 1897) 140.

This last cited case also holds that a condition of a contract of employment that the servant will never make use of or divulge trade secrets necessarily confided to him by the master in the conduct of the business is not invalid as being in restraint of trade.

W. M. Bittle, formerly of the Delta Laboratories of the E. I. duPont de Nemours & Co., is now chief chemist of the Duratex Co., Newark, N. J.

* * *

E. H. Frantz, formerly works chemist for the Combination Rubber Co., Bloomfield, N. J., also is now a member of the Duratex laboratory staff.

* * *

Paul D. Manning, chemist, formerly with the Chili Exploration Co., New York City, is now with the International Coal Products Co., Newark, N. J.

* * *

Volney R. Crosswell, University of Michigan, 1911, has been transferred from the Kenvil, N. J., plant of the Hercules Powder Co., where he had charge of plant development and statistics, to the assistant superintendency of the Gulfport naval stores plant of the Hercules Powder Co.

War Experience with Chemists and Chemical Manufacture in Great Britain

THE war has shown up very clearly many of the weaknesses in our technical educational system.* It also has brought many professors into close association with technical men and processes, and this, no doubt, has produced a greater appreciation on their part of the necessity for providing more technical instruction for students who propose to enter chemical industry. The resource and ingenuity displayed in meeting the complicated problems arising from the necessity for devising means of protection against gas attacks and the production of gases for attacks show that the country possesses ample chemical ability to meet any calls which may be made.

To meet the chemical industrial competition, closer co-operation between the more strictly theoretical and technical workers is essential, and, above all, a class of business and financial men must be developed whose education has been sufficiently broad to enable them to realize the sure foundations on which scientific conclusions rest, and to trust their scientific and technical advisers.

Chemical Enterprise and Ignorance

In this country there has been too little mutual trust and appreciation of each other, and it must be the serious endeavor of all concerned to develop such sure methods of working out new processes in all details, and clearly presenting the results, that the business man may have a well-defined picture of the advantages to be gained, and the cost to be incurred, in so far as the factory is concerned.

Chemical enterprise has suffered much from the comparative ignorance of many who entered upon its difficult path. On the one hand, the air of mystery which often surrounds it to the lay mind leads to expectations of almost magical results and exaggerated hopes which are rarely fulfilled. The business man often is not entirely to blame, for the chemical projects often have been presented to him in a very insufficiently considered manner, so that the attractive points—although no doubt truly put forward—were not sufficiently counterbalanced by a well-reasoned statement of all the sides of the question. Hence disappointment and loss of faith, or, at any rate, considerable scepticism in regard to future chemical projects.

On the other hand, if a non-scientific man has the final decision in regard to a chemical process, his lack of understanding of his technical staff and of faith in their requests, which may go against his so-called common sense, may be as prejudicial as the unreasoning hope before referred to. Unfortunately, this trouble arises from the lack of general scientific knowledge among all classes of society, and the failure to appreciate what scientific work stands for, as well as reluctance to make use of the scientific information which is available.

But if we are to hold our own in the world competition, the attitude to chemical industry must be altered very considerably. Greater knowledge on the part of those directing chemical work and the substitution of the rule-of-thumb men, who are often in complete charge of complicated processes, by intelligent chem-

ists who will make it possible for real progress to be made, are among the more obvious reforms to be introduced. Shrewd common sense and good powers of observation have enabled some of our non-scientific owners or managers of chemical factories to achieve sometimes a considerable amount of success, which has developed in them a corresponding contempt for, and distrust of, scientific control.

It must be admitted that when a young chemist has been taken on in such a works the results frequently have been unsatisfactory, due to lack of knowledge on both sides. Truly, Solomon was right when he insisted: "Get wisdom, get understanding." To get it, however, implies hard work and a certain amount of modesty which does not count too much on the influence of heredity.

Plant and Process Control

Our teaching institutions do not turn out industrial chemists ready to step into a works and successfully control processes straight away; nor perhaps is it to be expected or desirable that they should, for, after all, works' experience and the controlling of men can only be learned in a works. Sometimes the young chemist's position in a works run on rule-of-thumb principles is very trying. His inexperience may lead him into trouble, and his mistakes will cause unholy joy to the rule-of-thumb foreman and anger or dissatisfaction to the uncomprehending employer, with the probable result that he is confined entirely to the laboratory or even dismissed, and scientific control has thus apparently been found to be a fraud. Or he may develop an unjustified contempt for the "rough and ready" people with whom he has to work, forgetting that the ability to produce something, although unable scientifically to understand and explain the process, is worth more in a works than scientific comprehension of the process along with lack of technical ability to carry it out, or knowledge of pitfalls, should a change be undertaken in the existing practice.

It seems ridiculous to have to plead for the full and proper use of chemists in chemical works, but to those acquainted with the smaller works, and even some of the larger ones, it is known that the necessity exists. The difficulty largely would be solved if men with good chemical training were in charge of chemical works, for then they could see to the works' training of the young chemists who came under them and prevent them from making rash experiments and, at the same time, utilize to the full extent any knowledge or initiative which they might possess. Above all, such a manager would not be jealous of the chemist.

Repeated opportunities of visiting during the war most of the French factories employed in making explosives and allied chemical products filled one with great admiration for the work accomplished and the developments carried out, and it is evident that a chemical industrial renaissance has taken place in France, and manifestly they intend to develop chemical manufacture, which the war has shown they can carry on well.

In this country there has also been great chemical development, and a new spirit of scientific control and efficiency has been made known widely. Magnificent results have been achieved, but not through rule-of-

*Introduction by W. Macnab to "Preliminary Studies for H.M. Factory, Greta, and Study for an Installation of Phosgene Manufacture," issued by the Ministry of Munitions (Department of Explosives Supply).

thumb methods, which one would fain hope were buried for ever. It has been shown abundantly that the chemical knowledge and ability in this country, when adequately directed, can hold its own with that of any other land, but the stimulus of the common aim of quantity of output, and excellence of production, generated by the war, must not be allowed to die out.

Every endeavor should be made by professors and students, technical and business men interested in chemical manufactures, as well as by the Government, to get to understand the aims and requirements of each other, and co-operate in remedying any weakness in our system, and in developing chemical industry on sound scientific lines. Progress means change, and the chemical manufacturer should be prepared for having one process ousted by a newer and better way of working and should reckon with the necessity for scrapping plant from time to time if he is going to keep pace with improvements.

New Methods

Sometimes chemical enterprise is deprecated on the ground that no sooner is one method established than a new process threatens to supersede it, and therefore there is no certainty of permanence. A truly progressive spirit is necessary, and the mental laziness which tends to condemn new ideas because they upset a smoothly running process must be replaced by greater alacrity to undertake new methods with all the attendant trouble, otherwise a back seat will soon be taken by the firm or nation which will not wake up and keep awake.

More friendly and intelligent co-operation between masters and staff and ordinary workers will do much to make progress easier. Already there are indications of sounder and more humane ideas coming to the surface. Seeing we all have to spend the greater part of our life working in some capacity or other it is surely worth while endeavoring to make the work as interesting as possible.

All the chemical manufactures of the world have been greatly developed and stimulated by the war, and competition will be keener than ever on all sides. The old rule-of-thumb practice which prevailed in so many of our chemical factories must go and be replaced by thorough scientific control of every stage of the process. The necessary data and information are available in the country, and there are plenty of chemists with brains who can carry on and develop the good work begun.

The young chemist who starts work in a chemical factory finds himself confronted with plant instead of apparatus, much of which involves mechanical devices of various kinds, pumps and blow casks, moving liquids, mechanism and compressed air for agitating liquids, various methods of applying heat, etc. He should make it his business to get first-hand knowledge of the way each part of the plant acts and a thorough understanding of the principles on which it works and is constructed.

To do this he should take his coat off when a breakdown or stoppage occurs and see for himself what has been the cause, and learn and help to put matters right. Only in this way can he develop that knowledge of the capacities of a plan and sympathy with it, which will enable the best results to be obtained. A plant should be treated well and considerably, and its legitimate working capacity not overtaxed. Careful attention to its smooth running and maintenance in good condition will be richly repaid in steady and uniform output.

There is nothing *infra dig* in a highly trained scientific man doing the manual work involved in any of the processes under his control. Thereby he acquires a greater sympathy with and understanding of the men who have to do the regular manual work, which enables more just judgments to be formed as to what constitutes a fair day's work, and develops a mutual respect between chemist and workman. One does not rejoice in dirty work *per se*, but as a means to an end, viz., the intelligent understanding of plant and process—it should be cheerfully undertaken when occasion arises. Also the more carefully a plant is controlled the fewer interruptions and occasions for rough work will arise.

Yields and Losses

In the laboratory the chemist is trained to work quantitatively in so far as the main constituent he is preparing or substance he is analyzing is concerned, but he seldom is required to account for the quantity of reagents he employs or the amount of heating or cooling and water for washing he utilizes to effect his end. In the factory these questions become of first-rate importance and must be carefully attended to. Every part of the process should be quantitative, and thereby it acquires added interest.

The plant should be carefully calibrated, so that accurate measurements and weights of all materials used can be ascertained, and frequent stocks taken in order that yields and losses may be accurately known and any departure from the normal at once detected. Let the chemist keep prominently before him in large figures the losses, so that they may be a constant incentive to greater efforts to bring them down to the irreducible minimum.

In order that the chemist in charge of a process may work it to the greatest advantage he must be provided with all available knowledge on the subject, and encouraged to investigate by means of laboratory and plant experiments all obscure points and losses. To this end he should be taken as far as possible into the confidence of his employer in regard to costs, so that he may realize the necessity for economy in all directions and be able to measure in one of the terms of industrial success, viz., money, the results of modifications and improvements which he may introduce.

Intelligent and sympathetic co-operation between those in charge of different departments is necessary if the greatest efficiency is to be obtained. Some works have followed the opposite practice and kept the sections in watertight compartments. Profits have, no doubt, been made under such system, but not so great as when the heads and their assistants have opportunity to discuss their several problems together and help each other's hands. Without this co-operation the nation loses greatly both in material and the improvements which are sure to flow from the brightening of intellects by free discussion together.

It sometimes happens that owing to exceptional circumstances profits are made alongside of great waste of material. Such a state of affairs is a national misfortune, and, apart from the loss of material, which is also liable to be a nuisance to other people, it is demoralizing and engenders a careless unscientific spirit in those conducting the operations. Preventable waste of any kind should be considered a sin against mankind.

One of the most powerful aids to success would be the intelligent and loyal co-operation between employer and employee with the object of getting the best results from the process being worked. Interest in the work in hand leads to better work being done, and one

tendency of the time seems to be a revolt of the individual from being regarded as a "hand" or human machine, and a demand that some of the necessary monotony of the daily task should be brightened by learning done and the ideals to be striven for. The work of a chemist in a plant, although much more varied, can become monotonous, too, unless he can see beyond the immediate daily round, and have the interest and stimulus of knowing the profit or loss on his operations, while his attention should be concentrated on the production of the manufactured article at the lowest cost and greatest efficiency.

But a profit—even a good profit—on a product is not the only criterion of true success. The health conditions of the work people are of paramount importance for successful work and contentment. The experience at H.M. Factories, where the "Welfare" arrangements were best carried out, showed that it paid handsomely

to look after the comfort and well-being of the work people.

It is realized that the conditions under which the Ministry of Munitions conducted the various factories under its control were somewhat abnormal, but the advantage of letting the chemist and those in control of plant and processes have as full knowledge as possible of the results of working their own special department, as well as those on which they depended, was abundantly justified in the living interest which most of the men took in their work and the excellent results which they attained.

The common aim that united all during the war in doing the best they could for their country showed the advantage to be obtained if employers can enlist the sympathetic intelligence of those they employ, and let them feel they are part of one living corporation out to make an ideal of the actual, and have efficiency and harmony as the daily conditions of work.

Integration in Glass Manufacture

In pursuance of a policy of absorption of manufacturing enterprises either contributing supplies or furnishing commodities conveniently marketed with its own, the Pittsburgh Plate Glass Co., with plate glass factories located at Creighton, Ford City and Charlot, Pa., Kokomo, Ind., Crystal City, Mo., and Courcelles, Belgium, will acquire the plant and business of the Columbia Chemical Co., Barberton, Ohio, manufacturers of caustic soda and soda ash, whose sales agents are the Isaac Winkler & Bros. Co., Cincinnati, Ohio, and New York City. The Columbia Chemical Co. has an outstanding capital stock of \$5,966,000 and net assets of value far in excess of that amount. The Barberton plant has a daily production capacity of 700 tons of soda ash and caustic soda, requiring for this output about 1,200 tons of limestone and 1,000 tons of coal.

The Pittsburgh Plate Glass Co. was organized in 1883 and has been a consistent money-maker, with gross sales in 1918 of over \$40,000,000, about twice those of four years before. In 1900 it purchased 49 per cent. of the capital stock of the Patton Paint Co., Milwaukee, Wis., and in 1901, 48 per cent. of the capital stock of Rennous, Kleinle & Co., Baltimore, Md., later acquiring majority control of both companies.

Control of the Pitcairn Varnish Co. and of the Corona Chemical Co., subsidiaries of the Patton Paint Co., fell later in the lap of the Glass company in the shape of stock dividends.

The Patton-Pitcairn Co. has been organized to acquire the capital stocks of these four companies and their subsidiaries, including that of the Red Wing Linseed Oil Co. The Pittsburgh Plate Glass Co., the Patton-Pitcairn Co. and the Columbia Chemical Co. will be consolidated on such basis of stock allotments as will preclude any minority interest in any department of the business and provide for the direct ownership and operation by the consolidated company, which will bear the name of the Pittsburgh Plate Glass Co. of the glass, paint, varnish, brush, chemical and other manufacturing activities of the business.

The consolidated company will have an authorized capital stock of \$37,500,000, of which \$30,734,200 will be issued at once to the stockholders of the absorbed companies, whose net assets are approximately \$61,000,000, representing a surplus of \$30,000,000 which, aside from working capital, is represented by property.

The remaining unissued stock will be used in the discretion of the directors in the later payment of a stock dividend.

A New Wage Payment Plan

The slump of the early part of the year in the automobile industry immediately was reflected in all attendant industries and naturally first in the manufacture of tires and tubes.

A system whereby, with reduced operating force, increased output per man and more even regulation of production, is possible, merits the consideration of production managers where analogous conditions some time may warrant its use.

The B. F. Goodrich Co., Akron, Ohio, laid off about 4,000 of the 29,000 operatives employed earlier in the year and is running three hour shifts five days a week. Although total production has been somewhat curtailed the present force is working under a new system which has increased output per man and is more satisfactory to both employees and the company.

When it became necessary a short time ago to temporarily reduce tire production, in an effort to retain as many men as possible, the company decided to adopt a plan which had been used in a small way in one of the mechanical goods departments. The plan provides for "pooled" operations by various departments and payment is made on a basis of a certain volume of production, shared in proportionately by the various members of each department.

For example, the compounding department, which mixes crude rubber and chemicals used in the manufacture of various rubber products, is told to deliver a specified amount of various compounds. The department is paid a fixed sum for each ton of compound delivered and the members of the department share proportionately in this payment. In other words, the men are not paid by the hour or day nor do they operate on a piece-work basis. It is more or less a matter of volume. If 80 men in one group can deliver as much compound as 100 men in another group the members of the first gang will receive individually more money than those of the second. This increases personal efficiency, for the men themselves see to it that no one shirks. At the same time the company can regulate production in a more satisfactory manner than heretofore.

Shubert Kloss, Worcester Tech., 1912, has been advanced to the works managership of the Brunswick, Ga., naval stores plant of the Yaryan Rosin & Turpentine Co., after six years progressive experience in the high explosives division of the operating department of the Hercules Powder Co.

CHEMICAL AGE

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A Consolidation of
The Chemical Engineer
and Chemical Age



THE development of character and the inculcation of unselfish devotion to the common welfare which is glorified as patriotism, the last acquired and least firmly fixed of the emotional attributes that adorn mankind, are vastly more important than the development of any technical procedure of poison-gas production.

The egregious war-time blunders made in the mobilization of our industrial forces in shipyard and shop should not be accepted as a precedent for the perpetuation of the abuses of the Pension Office.

With the organization of the Chemical Warfare Post of the American Legion, with an initial membership and an executive committee comprising the flower of technical ability in pedagogy and industrial administration, it is to be hoped that a warning hand will be raised to check the easy prostitution of cowardly politicians whose conduct, in capitalizing for personal advancement the itching desires of a class at the expense of the whole, is the crowning disgrace of democratic government.

MERIT in one field carries the obligation of its translation to another. Otherwise how would you explain the penetration of new ideas in the general progress of industry?

We venture the assertion that in the next four years technical men as advisors and administrators in national affairs will be accorded a recognition never dreamt of before.

This will be the result partly of the recognition of their labor in a time of national peril, partly of the development of a class consciousness that shall demand in the field of political administration the efficiency of industry, and partly of the absolute necessity in an industrial society that men trained for industry shall, in the process of promotion, be called upon to solve its larger problems as they affect and determine the national welfare.

Chemists, by virtue of their training and their work, carry the responsibilities of all educated to save and enhance that advantage by sharing it.

Therefore, when chemists gather together let no opportunity be lost to impress not only upon a receptive public, but upon that conservative element of our people without which their effort is of no avail, that economic sanity is their precept and practice and that in their ambition and in the results of their work lie the seeds of eventual leadership.

THE selling of a commodity, equipment or skill materializes the profit which has been the encouragement of its creation.

This profit blesteth him that takes it and him that gives it in the reinforced capacity of each to serve; for without this respective contribution to the crowning achievement of work the whole fabric of human relations, laboriously built up, will disintegrate and disappear.

The increasing appreciation of the dignity of salesmanship has made it a profession whose practitioners have consigned to the limbo of the obsolete the doctrine of *Caveat Emptor*. He is no salesman, but a trickster, who cannot go back to his customer with the satisfaction of service performed, which is the chief mainstay of the *entente cordiale* of seller and buyer.

Particularly is it true of chemical salesmanship, whether it be in supplies, or in the products of chemical industry, that the salesman is a teacher.

He must not only know his goods but their application, and must possess, if he is to grow, that alertness, demanded in a similar degree in no other line, to develop new avenues of consumption.

Chemical education, brightened into keen resourcefulness by contact with men, is the essential qualification of chemical salesmanship.

THE worker in the chemical industries, however humble his connection, who attended the Chemical Exposition and was not benefited by it, either is misplaced or is not giving the industry the best there is in him.

Not to enjoy the exaltation of feeling, "all of which I saw and a part of which I am," is a direct invitation to the self-scrutiny of his usefulness.

The chemical industry will grow only to the degree that its leaders grow and receive the loyalty of the ambitious co-operation of their fellows.

The value of the Exposition lies not so much in goods sold, or in friends made, as in the stimulation of endeavor which is the mainspring of progress.

WHAT the administrative chief of an educational institution with 31,000 students says about men should not be lost on those of academic origin alone, but applies as well to those who have not enjoyed the impetus to growth inherent in technical training; for education is a process not confined to scholastic walls, and which can justify itself only by results.

Without resort to the refinements of the dialectician, we can say that Dr. Butler identifies the earmarks of an educated man in (1) ability to tell what one knows, (2) consideration for others, (3) wholesome ideals,

(4) sound thinking, (5) adaptability, and (6) never getting rattled.

The wisdom of Dr. Butler's life-time experience as an educator is indicated by the primary place he gives to a man's ability to express himself in good English.

By this is meant not merely speech, but the use of the correct linguistic instrument to tell or write what one knows. Not only in this trait is the educator's work best expressed, but it is where the technical man falls down hardest.

IDEAS are conceived to be born. If education cannot alleviate the labor of expression, the subject is hopeless, and the teacher's time is wasted.

This fact is recognized in the increasing attention given it by technical educators in the training of industrial scientists.

Sound industrial growth is predicated upon the free interchange of ideas. Technical and trade journalism is at once its medium and its mirror.

Technical men should recognize the potency of the printed page as an instrument in personal progress, and neglect no opportunity to avail themselves of this aid to recognition.

SENATOR WADSWORTH, of New York, is the legislative sponsor of the bill advocated by some government scientists and certain teachers of technical men to commit the government to the nationalization of industry in the utilization of the Alabama nitrate plants for fertilizer manufacture under government auspices.

This is a subject for the display of sound thinking on the part of technical men.

The National Board of Farm Organizations is reported as having secured approval of this trespass upon private enterprise from Senator Harding, who declared himself, as regards railroad management, against "the blighting hand of government operation."

Communitic experiments abroad, as examples of repression, should be sufficient to impel every technical man to surround with the sanctity of a shrine the free play of individual initiative in American industry, and to invoke against all who would assail it the tri-une simplicity of democratic government to maintain justice, to preserve order and to provide equality of opportunity.

THE administrative genius of Herbert Hoover compels a conscientious pronouncement; in the face of which the president of the Chemists' Club, we might say almost with effrontery when we consider his myopic observation, breaks into print in the *Sunday World* in a querulous effort to stave off the appointment of a receiver for the present administration.

Is Ellwood Hendrick so impervious to the settled convictions of technical men who demand in government not sentiment but sense—of that variety that find its best exemplification in the successful manufacturing organization, that he is oblivious to the main issue?

This issue is: Shall we have the translation into constitutional government of the team-work of production, or its perversion to autocracy that panders to class?

DEFLATION for which the consumer long has prayed is now in full sweep throughout the world, under such conditions that whatever losses may be incidental to the stabilizing process fall upon those most able to bear them and in a position to recoup in the renewed demand inevitable with reduced prices.

Supporting the economic structure is the inhibition of repressed consumption whose weight bears down the ascending curve of prices and preserves prudent enterprise from panic. Never have fundamental conditions been sounder, or more propitious for the elimination of the inefficient producer.

War-time demand bred him with the fecundity of the rabbit and only deflation, with its wholesome, untampered competition, is possible for his removal.

Thus Nature preserves those who really serve and casts off the parasites of the economic body.

INDUSTRIES with large inventories are under the compulsion of heavy marking-down, as is everyone with over-stocks all along the line of the extractive, producing and distributive processes.

We all know the weakness of co-operative enterprises: In the sunshine of profit there is rejoicing, but dispersion follows the discouragement of losses which no one wants to bear.

The same psychology retards the current stabilization and in its slowness makes its easy, and magnifies the selfish inconsistency of human nature that expects to make money all the time.

THE manufacturer does not want to close his plant for his money is made by operating it, with an output in volume and value that carries the costs of materials, labor, capital and managerial ability, and permits a price that encourages the consumer to buy.

Without the encouragement of consumption, operation—service—is futile.

The manufacturer wants to pay high real wages, for it is the greatest encouragement to consumption.

To enjoy the welfare that flows from activity and to encourage increased production in a time of under-consumption, which can be smothered only under the lower cost of needed things, never has American industry been more hospitable to every device, plan or process that chemical and engineering ability can suggest.

Reduction of production costs should not await the slow and spotted phenomena of deflation, with its temporary losses, but should be met by the introduction in the plant, everywhere in the transport and transformation of material, of every change that saves a dollar, or eliminates the human hand.

To chemists and engineers American industry should look for Protection, and not to politicians.

Presentation of Grasselli Medal to Dr. Allen Rogers

THE Grasselli Medal was established by the Grasselli Chemical Company of Cleveland, Ohio, to be awarded annually for the paper presented before the New York Section of the Society of Chemical Industry which shall, in the opinion of the Medal Committee, offer the most useful suggestions in applied chemistry.

The Committee of Award, at its meeting September 17, 1920, voted unanimously to bestow the Medal for this year upon the Honorary Secretary of the American Section, Dr. Allen Rogers, for his paper entitled "Industrial Uses of the Shark and Porpoise," printed in the Journal of this Society for January 31, 1920 (Vol. 39, No. 2, pages 9-10 T.).

The occasion of the presentation of this distinction upon a deservedly popular and able chemist was the joint meeting on Oct. 8 at Rumford Hall, Chemists' Club, of the American sections of the Society of Chemical Industry and the New York section of the Societe de Chimie Industrielle. The presentation address was made by Dr. Marston Taylor Bogert, professor of Organic Chemistry, Columbia University.

Dr. Bogert's Address

As a personal friend both of the donors and of the recipient of the Medal, it will be understood how pleasant I find my task this evening as the official to make the formal presentation.

Dr. Rogers was born in Hampden, Maine, May 22, 1876, and graduated from the University of Maine in 1897 with the degree B.S. in the chemistry course. For three years following he remained at his Alma Mater as instructor in chemistry, receiving the degree M.S. in 1900. Migrating then to the University of Pennsylvania, he continued his graduate work there, and was awarded the Harrison Fellowship for 1901-2. In the latter year, the university conferred upon him its Ph.D. for a research concerned with certain complex inorganic acids, the results of which were published in the Journal of the American Chemical Society.

For two years longer he remained at the university, first as Senior Fellow (1902-3), lecturing to graduate students on analytical and physical chemistry, and later (1903-4) as instructor in organic chemistry.

In June, 1904, he abandoned this temporarily to enter the employ of the Oakes Manufacturing Company, Long Island City, N. Y., as research chemist, where his investigations on problems related to the leather industry led to several patents being taken out by the company.

In September, 1905, he withdrew from the Oakes Manufacturing Company and returned to the ranks of the teachers, as professor in charge of Industrial Chemistry at Pratt Institute, Brooklyn, N. Y., the position he still occupies.

Taking up his duties there with characteristic energy



ALLEN ROGERS, B.S., M.S., Ph.D.

and enthusiasm, he organized the course in Industrial Chemical Engineering, making use of miniature plants to train young men for positions as foremen and superintendents in large-scale manufacturing establishments. This undertaking has been conspicuously successful from the outset, and already many of the graduates hold prominent places of great responsibility in our chemical industry. It has been my good fortune to attend some of the general gatherings of these alumni, and I know the well deserved affectionate regard and high esteem in which they hold their leader.

For many years Dr. Rogers has made a special study of leathers and tanning, until now he is widely recognized as one of our foremost experts in this important field. Patents have been granted him for various processes of treating leather and other patents are pending. His most interesting work in this direction is that recorded in the paper for which the Medal is

awarded, namely the utilization of the shark and porpoises as sources of leather. In making the award the Medal Committee entered upon their minutes a note expressing their judgment that Dr. Rogers' paper was a record of work accomplished by him in recovering oils, manufacturing fertilizers and fine leathers, through which he contributed much information and some entirely new processes in applied chemistry.

In the time of our country's need he promptly and patriotically sacrificed all personal selfish interests and volunteered for military duty, being commissioned Major in the Chemical Warfare Service, where he was put in charge of the Industrial Relations Branch, a post of considerable responsibility, involving indirectly classification of industries into the more and less essential, and determining recommendations of exemption from military duty for those chemists who were more needed at the factories than at the front. Many a plant would have had to close its doors or seriously curtail its output, and the military preparation of the country would have been considerably delayed but for the energy and ability with which Major Rogers fulfilled his duties. When the war had been won he was equally active in aiding chemists discharged from the army to get back into lucrative positions once more, an assistance which was deeply appreciated by many demobilized colleagues.

Dr. Rogers is the author of a "Manual of Industrial Chemistry," in the preparation of which he was aided by over 40 distinguished collaborators.

This standard treatise has gone through three editions and is now used as a text in more than 50 colleges and technical schools. He is also the author of "Elements of Industrial Chemistry" and "Laboratory Guide of Industrial Chemistry" (2 editions).

A member of leading chemical and technical societies, and consulting chemical engineer for various corporations, he has recently been called upon by General Fries

as an adviser in connection with the educational program planned for Chemical Warfare Service men at Edgewood, Md., so that the men may "learn while they earn."

A patriotic and useful citizen, his aims and efforts have ever been constructive and never destructive. He has been more concerned about what he could give to his country than about how much he could get out of it, and his activities have been of direct benefit to this community and to the progress of applied chemistry.

It therefore gives your host of friends particular pleasure, Major, to see this Medal awarded to one who has for so many years labored so unselfishly for others and who has devoted himself so assiduously and so successfully to the development of that branch of chemical industry to which the paper relates. May it bring to you much happiness, and may it prove an inspiration to yet further achievement!

Dr. Roger's Response

My Dear Colonel Bogers: I certainly appreciate your kind words and hope that I may be worthy of all the good things you have said.

It was a great surprise to me, I assure you, when I received the information that my paper on "Industrial Uses for the Shark and Porpoise" had been deemed of sufficient merit to warrant recognition by the award of the Grasselli Medal.

The commercial utilization of the shark is a matter that has interested me for several years, and if I have

done anything to interest others in my friends of the deep, it is, of course, very gratifying. Sharks have always been considered as scavengers and of no benefit to man. My work, however, has shown me that they have some good points in their favor. If we take advantage of them I feel confident that a great industry eventually may be established.

Already much has been accomplished in this direction. A fairly large plant is in operation at Mørehead City, N. C., where the fish are caught, the skins removed, the livers rendered for oil and the flesh converted into fertilizer stock. Another plant is located at Sanibal Island, Fla. At the tannery in Newark, N. J., about one thousand skins are being treated each week. Plans are now under way for establishing other stations at various points along the Atlantic and Pacific Coasts, while the existing plants will be greatly enlarged.

As time goes on and we learn more about these despised creatures we no doubt will discover new uses for the various parts of their anatomy, and who can tell what benefit then may be derived.

In accepting this Medal I wish to thank the Grasselli Chemical Company, through whose generosity the award is made possible.

I desire to express my appreciation to the members of the Medal Committee for their consideration and I want to thank you personally for the friendship you have manifested and the inspiration you have given to me in making the presentation.

Personal Notes

E. H. Frantz, formerly works chemist for the Combination Rubber Co., Bloomfield, N. J., is now a member of the Duratex Co., Newark, N. J., laboratory staff.

* * *

W. L. Filmer will have charge of the newly opened sales branch of the Monsanto Chemical Works, St. Louis, Mo., at 209 North La Salle street, Chicago.

* * *

A. W. Magnum, soap chemist, formerly with the Proctor & Gamble Co., is now with Lever Bros. Co., Cambridge, Mass.

* * *

Dr. Carl L. Alsborg, chief, Bureau of Chemistry, Dept. of Agriculture, was elected president of the Association of American Dairy, Food and Drug Officials at its 24th annual meeting in St. Louis.

* * *

W. F. Parish, technical director, Sinclair Refining Co., is directing a movement having for its object the formation of the American Society of Lubricating Engineers.

* * *

The following are recent departures from the du Pont organization: Dr. Thos. H. Norton is now engaged in consulting work in New York City, with residence at White Plains, N. Y. R. H. Currie is now assistant superintendent of plant of the Acheson Graphite Co., Niagara Falls, N. Y. F. W. Stetson is now at the Barrett Co.'s Edgewater, N. J., plant.

* * *

Major Chas. L. Joly, who served during and since the war in the Chemical Warfare Service with the temporary rank of Lieutenant Colonel, has been designated head of the Army Chemical Warfare School, personnel of which is being reorganized and its location transferred from Lakehurst Proving Ground, N. J., to Edgewood Arsenal, Md.

I. F. Laucks, Inc., analytical and consulting chemists of Seattle, Wash., are about to establish a branch at Kobe, Japan. They expect that the new office will be open about November 15. Samples of shipments from Japanese ports will be inspected and graded at the new office. H. D. Hennis will have charge of the office. He will be assisted by G. S. Tilley, chief chemist, and M. L. Snow, agronomist.

Copper Production and Fertilizer Manufacture

The Anaconda Copper Mining Company, Anaconda, Mont., will begin soon the quantity production of its super-phosphate fertilizer which, containing 48 per cent. of available phosphoric acid, which is about three times the amount present in the ordinary eastern-made fertilizer, will permit such absorption of cost of long freight haul as will make possible encroachment on the southeastern and southern markets which consume the bulk of fertilizers used in the United States, to say nothing of its domination of the western field.

The ownership of high-grade phosphate deposits in proximity to its mining operations, together with the production of sulphuric acid from the roaster gases evolved in smelting copper, zinc and lead sulphide ores, puts the company in an exceptionally favorable position in the manufacture of super-phosphate.

For nearly forty years the Anaconda Copper Mining Company has been the chief producer in the Butte, Mont., district, which in that period turned out 100,000,000 tons of copper ore. The copper content has amounted to 8,000,000,000 pounds. In 1884 the Anaconda plant handled 500 tons in twenty-four hours. The present daily capacity is 17,500 tons, or thirty-five times as much as in 1884.

Since its organization, up to and including June 30, 1920, the company has paid \$170,110,625 in dividends. In all probability these dividend disbursements exceed those of any other mining company in the world.

Arsphenamine Production by the Massachusetts Department of Public Health

By Hermann C. Lythgoe

Director, Division of Food and Drugs, Department of Public Health, State of Massachusetts
President, American Association of Official Agricultural Chemists

DURING 1915, when it appeared that this country's supply of Salvarsan would be exhausted and possibly could not be replaced, Dr. Allan J. McLaughlin, then Commissioner of Health of Massachusetts*, conceived the idea that the state should make and distribute free of charge a chemical substance indispensable in the prophylaxis of syphilis, under the same general principles that antitoxins and vaccines are now made and distributed. He, therefore, on the part of the Massachusetts State Department of Health, introduced a resolution in the state legislature during 1916, which resolution was enacted into law in the following form:

Resolution Authorizing the State Department of Health to Provide for the Prevention and Suppression of Syphilis.

RESOLVED, That there be allowed and paid out of the Treasury of the Commonwealth a sum not exceeding ten thousand dollars, to be expended under the direction of the State Department of Health in purchasing dioxo-diamino-arseno-benzol and its derivatives, or other substances of equal or greater value in the prevention of the transmission of syphilis, or in making investigations as to the practicability of manufacturing, or in manufacturing, the same for free distribution to boards of health, hospitals, dispensaries and physicians for use within the Commonwealth in the suppression of syphilis in such manner and subject to such rules and regulations as the State Department of Health shall prescribe. (Approved April 11, 1916.)

About the time this resolution was passed diarsenol and arseno-benzol appeared on the market, and a representative of one of the houses selling these drugs endeavored to sell the drugs to this department as provided in the provisions of the resolution. The prices, however, were felt to be altogether too high, and the department decided to spend some of the money in research work in the manufacture of the drug. Owing to the fact that the department possessed no employee who was an expert in recent methods of synthetic organic chemistry, it was essential to obtain the services of men skilled in this line of work. Considerable delay occurred in selecting the place where the work was to be done, and in obtaining the proper men to carry on the research, but in July, 1916, the work was begun in the already too crowded laboratory of the Food and Drug Division.

Personnel and Plans

Dr. Samuel P. Mulliken, of the Massachusetts Institute of Technology, was appointed consulting expert in organic chemistry, and Mr. Willard B. Crandall, a recent graduate of the Massachusetts Institute of Technology, a young man with exceptionally good knowledge of organic and physical chemistry, was employed as research assistant. The literature upon the subject was carefully reviewed by Dr. Mulliken and by Mr. Crandall, and it was decided to attempt the synthesis along the following lines:

1. The manufacture of crude arsanilic acid from aniline and arsenic acid.

2. The preparation of atoxyl from the crude arsanilic acid and sodium hydroxide.
3. The preparation of pure arsanilic acid from the atoxyl.
4. The preparation of the oxalyl derivative from the pure arsanilic acid and oxalic acid.
5. The preparation of nitro-arsanilic acid by nitration of the oxalyl derivative with subsequent removal of the oxalyl group by hydrolysis.
6. The substitution of the hydroxyl group for the amino group by heating the nitro body with sodium hydroxide.
7. The preparation of the arsphenamine base by reduction of the oxynitrophenylarsonic acid in alkaline solution with sodium hydrosulphite in the presence of magnesium chloride, and the preparation of the hydrochloric acid salt by solution of the base in methyl alcohol-hydrochloric acid solution and precipitation by pouring into ether.

Development of the Work

Difficulties were encountered in all stages of the synthesis, but those in the last step by far exceeded all encountered in the rest of the work. Mr. Crandall succeeded in successfully producing all the intermediate products, but had difficulty in successfully carrying out the last step. Mr. Lewis I. Nurenberg, one of the assistants of the Food and Drug Division, and the writer, then worked with Mr. Crandall and Dr. Mulliken and finally succeeded in producing a compound which was of unusual purity, due to the exceptional care with which it was made. This sample was produced on January, 13, 1917.

After further experimental work a few large batches were made by the above process, were put out by the department and proved to be satisfactory.

Owing to certain difficulties in carrying out the process, it then was decided to change the method of preparation by taking the pure arsanilic acid and by the diazo reaction to substitute a hydroxyl group for the amino group, and separate out this compound as the sodium salt. This compound was then nitrated, producing the same nitro derivative as by the previous process. This change cut out one process.

The Process

The work was carried on in this manner for about two years. Recently, successful experiments were carried out in making the product from phenol which further reduces the number of steps. The process consists in heating phenol with arsenic acid and separating out the resulting compound as the sodium salt. This compound is then nitrated and the nitro body is then reduced with hydrosulphite to arsphenamine.

In the first process used there are five intermediates. This was cut down to four in the second process, and to two in the third process. The reactions involved in these various processes are shown in the accompanying diagram of the development of the arsphenamine molecule.

The Procedure

In some respects the compound made from phenol is better than that made from aniline. The processes in detail are as follows:

In the preparation of arsanilic acid a glass-lined tank

*Now Assistant Surgeon-General, United States Public Health Service.

of fifty gallons capacity with a heating jacket is employed, in which is placed the mixture of aniline and arsenic acid, which is then heated for a period of three hours at a temperature of 165°C . This is cooled somewhat, some water added, and sodium hydroxide is added to neutralize the arsenilic acid produced. The aqueous layer is then separated from the aniline layer, and the crude arsenilic acid is precipitated with hydrochloric acid. The excess of aniline is recovered by steam distillation. The crude arsenilic acid is purified through the medium of the sodium salt known as atoxyl. By the usual procedure of the diazo reaction, the pure arsenilic acid is dissolved in sulphuric acid, and sodium nitrite is added at the proper temperature.

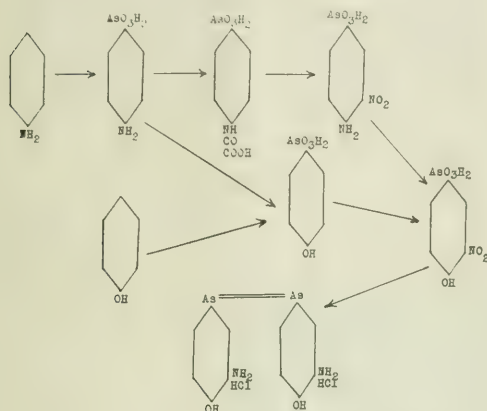


Diagram of the Development of Arspenamine.

After the reaction is complete, the solution is boiled, neutralized with barium carbonate, filtered, evaporated and the sodium salt of the phenol arsenic acid is precipitated with alcohol. This substance is then dissolved in sulphuric acid and treated with nitric acid at a temperature of about 0°C . After the nitration is completed, the solution is poured into water and when crystallization is complete, is filtered and the crystals are dried. This is the final intermediate body.

In the preparation of arspenamine, the hydroxy nitroarsenic acid is dissolved in sodium hydroxide, to which a small quantity of magnesium chloride is added; then the proper quantity of sodium hydrosulphite is added, and the mixture is heated at a temperature of 57°C and held at this temperature for two hours. This process is carried out in an enamel-lined tank with a cover and a stirrer. After the reaction is complete, the arspenamine base is filtered, washed and dried in a vacuum desiccator. This base is then dissolved in absolute methyl alcohol containing the proper quantity of dry hydrochloric acid gas. The solution is filtered and is poured into ether, whereupon the salt immediately precipitates. This is then filtered, washed with ether, dried in a vacuum desiccator, and is put up in vacuum ampoules.

In the preparation of the compound from phenol, the arsenic acid is first heated to a definite boiling point, the melted phenol is added, a return flow condenser attached and the mixture is heated at the proper temperature for eight hours. The mixture is carefully neutralized with barium carbonate until the excess of arsenic acid is precipitated. It is then filtered, evaporated, neutralized

with sodium hydroxide, is further evaporated and is precipitated with alcohol.

Efficiency and Output

Each batch necessarily must be tested for toxicity upon rats before it can be put out. The department is producing and distributing about 3,000 doses per month through the clinics which the department is operating. There are at present 16 of these clinics and the physicians who are administering the drug are thoroughly equipped and properly instructed in the method of preparation and administration.

This compound, except for its therapeutic properties, would be classified among the many chemical curiosities. It very easily decomposes in the presence of air, and when it oxidizes it produces a compound which is highly toxic. The substance being placed directly in the veins must necessarily be prepared for administration by one familiar with its peculiarities, and there are a few instances of severe sickness; and in some cases death has resulted solely from improper preparation of the drug for administration. Before administration the drug must be dissolved in distilled water, and must be neutralized with sodium hydroxide so that both the hydrochloric acid groups are split off and both the phenol groups are converted into the sodium salt. The administration of this drug is, therefore, the work of a specialist and should not be carried out by the average physician not familiar with the peculiarities of the drug.

The Abortive Alcohol-Tax Law in New York

The destructive effect of ill-considered tax legislation is illustrated by the law passed in the closing days of the last regular session of the New York State Legislature, whereby the liquor tax law was amended to embrace a tax of 30 cents on each gallon of alcohol produced or sold within the state for industrial purposes. Not only does this abortive legislation show that the power to tax is the power to destroy, but that in the imposition of taxes to provide revenue the purpose of such laws easily may be defeated. Industrial alcohol manufacture has been transferred to other states where the product is not subject to the tax and from which it may be shipped into New York for use without the payment of the tax. Resale within the state subjects the alcohol to the tax.

To avoid payment of the tax the user of alcohol, wherever possible, buys the alcohol without the state and to the extent of the tax has his competitor who has to buy it within the state at a disadvantage. Under such circumstances no producer of alcohol within New York can compete with those located without the state and shipping their product within the state for direct consumption.

The dealer in alcohol pays no tax on alcohol bought and sold without the state; when sold for delivery within the state, he is liable for the tax. If purchased from a New York producer, the alcohol is subject to the tax. As regards the dealer, therefore, all his sales for delivery either within or without the state carry the tax.

As a revenue measure this provision of the excise law is a failure. Its influence in the destruction of an important industry, the injustice inflicted upon many consumers, and the common annoyance of thoughtless legislation, demand its prompt repeal after January 1.

Sulphur Production for Agriculture

By C. C. Cunningham
Agriculturist, Texas Sulphur Co.

IT is the chemist who has confounded the conclusions of the doctrine of Malthus that population increases at a greater rate than its means of subsistence, and to whom with the engineer, agriculture looks for ways and means to transform, with the press of population, our vast domain of unused land to the purposes of cultivation.

Growing knowledge of plant physiology and nutrition is reflected in industrial enterprise to provide the means of maximum crop production. Just as "reading, 'riting and 'rithmetic" early were demonstrated as only the bare essentials of personal progress, so phosphorous, potash and nitrogen are found to be not the sole, essential plant foods, but that growth and maturity of seed require a variety of dietary only now beginning to be appreciated.

Demonstration of the value of sulphur as a condiment in fertilization immediately imparted value to deposits of sulphur too greatly contaminated with foreign matter to be available for industrial purposes in competition with enterprise that, by virtue of the genius of Herman Frasch, pumps sulphur from the earth and practically closes the markets of the world to the historic deposits of Sicily.

The beneficial results of sulphur as a fertilizer come from the action of sulphuric acid, formed in the soil, hastening the natural conversion of the inert mineral elements into available mineral plant foods, also stimulating the activities of nitrogen-gathering and nitrogen-fixing bacteria. The increase in yield and quality of the crop is almost as extraordinary as the practice is radical, compared to the established theory of fertilization to increase crop production.

Chemists claim the discovery of the action and effect of sulphuric acid in the soil means it is a working substitute for the nitrogen, phosphoric acid and potash ingredients of chemical fertilizers. It is a coincidence that this discovery comes just when the demand for fertilizer is growing enormously and there is a shortage of these fertilizer ingredients.

It is not claimed that sulphur is a fertilizer in the same sense that nitrogen, phosphoric acid and potash are used in chemical fertilizers, but that the action of sulphuric acid, formed in the soil, hastens all the natural processes of plant-food preparation in nature's soil laboratory, promotes the ability of plants to acquire atmospheric nitrogen, increases the preparation of organic nitrogen and all the mineral plant foods including available phosphoric acid and potash.

Answering the question, "Does not sulphuric acid in the soil contribute to the conditions to neutralize which we lime?" Yes, sulphuric acid has a tendency to create an acid condition and sulphur should not be applied on

sour or acid soil until it is sweetened by an application of lime. The only type of soil so far reported as failing to respond to the sulphur treatment in a beneficial manner has been sour or acid soil. Also lime is necessary to provide a base for the excess of acid formed in the process of oxidation and in the process of nitrification. This knowledge led to experimental work with a sulphur-lime compound of agricultural sulphur and reports from its use, as to its beneficial action on plant growth and crop yield, also its beneficial action as an insecticide in the soil, prompted the Texas Sulphur Company to manufacture agricultural sulphur-lime compound.

Answering the question, "How is the element sulphur transformed into sulphuric acid?" Raw sulphur is converted into sulphuric acid in the soil by a natural process of oxidation called sulfonation, by the bacteria *Rhodobacteraceae* and *Thiobacteriaceae*, said to be present in all soil containing organic matter. It has been found that regardless of the amount of sulphur applied to the soil about 75 per cent. is converted into sulphuric acid in about 120 days.

Publication of these discoveries resulted in extensive sulphur experiments by practical farmers on thousands of acres or crops, especially alfalfa, which have given extraordinary increased yields over adjoining fields not sulphur treated. The increase amounting to one, two, and three tons per acre while the same beneficial effect for four years is reported from the first field sulphured.



Non-Sulphured Hay. Sulphured Hay.
Fig. 1.—Reaction of Alfalfa to Applications of Sulphur.

The Texas Sulphur Co., Orange, Texas, is a pioneer in the development of domestic sulphur deposits for use in agriculture, and is an example of commercial enterprise predicated primarily upon the work of the agricultural chemist. B. V. Mateer, Pittsburgh, Pa., investigated the deposits of this company in Culberson Co., Texas, which are the most important occurring in a belt extending from the center of Culberson Co., over 150 miles northwesterly to the White Oak Mountains of New Mexico. In 11-ft. excavations, the removed material had a sulphur-content ranging from 12.7-81.62 per cent.; of that removed from the last four feet the sulphur-content was 31.61-40 per cent. Dr. Udden, Chief, Texas Geological Survey, estimates the depth of this deposit to be at least 2000 feet.

In their mineralogy and geology these deposits are very similar to the Sicilian deposits which have been the historic commercial source of sulphur and have been excavated to a depth of 1000 feet.

The sulphur in the Culberson Co. deposits of the Texas Sulphur Co. arises in two ways: (1) deposition by evaporation of ground water solutions of calcium sulphate; (2) action of hydrogen sulphide on gypsum in



Fig. 2.—Non-Sulphured Green Hay from 15 Feet of Swath Adjoining the Sulphured Swath. Weight, 11 Pounds.



Fig. 3.—Sulphured Green Hay from 15 Feet of Swath. Weight, 46 Pounds.

the presence of organic matter; therefore sulphur deposition is a present and increasing process where these conditions obtain. Organic matter reduces gypsum (calcium sulphate) to calcium sulphide which by the action of carbon dioxide, yields calcium carbonate and hydrogen sulphide which latter body, on oxidation, deposits sulphur. Experience with deposits of this character demonstrates that the sulphur-content increases with the depth of the deposit.

Home-Brew a Blessing to the Grape-Grower

Home-made wine has put the wineries of the country out of business more completely than the prohibition law, which still granted permission to manufacture the beverage, under a permit, but only for sacramental or medicinal purposes. A number of wineries in California last year took out permits for the manufacture of wine under the Volstead act, and considerable quantities were made.

The Eastern distributor, in turn, took out permits to sell it, and the wine was shipped eastward. Now it is not salable, as the narrow demand through the channels permitted by law are not sufficient to afford a market for the 1919 production. Illicit sales are not frequent enough to reduce the stocks held here and in other Eastern markets. The home-brew supplies the consumer at home, while in public places the sale of wine is not frequent. With whiskey it is different.

Advices from California show that few permits were taken out to manufacture wine this year and some of those who have permission are not manufacturing it. They find too much competition in buying raw stocks, as the green grape shippers, the raisin men, grape juice makers and others are in the field in full force.

Green grape prices, covering the varieties used for wine making purposes, were never so high. Prohibition has proved a blessing in disguise for the California grower. Instead of plowing up his vineyards, as he feared, he is extending them.

The demand for wine grapes in the Eastern markets has been heavy all season and there has been no slump in prices either at private sale in the wholesale market

The sulphur-content of the excavated material of the company's deposits, whose extent is estimated by the millions of tons, is 20-30 per cent., the contaminating material being lime, silica, alumina and organic matter chiefly bituminous. Mining is done by steam-shovel and the material is carried by motor-truck to El Paso where in a recently erected plant costing \$175,000, it is prepared for shipment for use as fertilizer in growing demand wherever it has been demonstrated.

or at auction. Then, too, it is common knowledge in the trade that the outlet for raisins has increased phenomenally because of their use for beverage making. Recognizing this the raisin packers have exerted their influence to keep open the normal consuming channels and to prevent a violent advance in carton and other raisins used by the legitimate trade. Dried black grapes, formerly of minor importance, have been in the limelight and have sold at prices which a year or two ago would have been regarded as impossible to secure. "Will it last?" the trade is asking. The boom in grapes and in raisins has been largely due to the home-brew. Any curtailment in that outlet through Federal action would instantly affect both markets, but in the meantime the grape grower is reaping a golden harvest and the 1920 crop promises to go down in history as a record-breaker so far as prices go.

New Belgian Artificial Silk Agency

The Fabrique de Soie Artificielle d'Obourg of Obourg les Mons, Belgium, has appointed L. Earnstein & Co., 345 Fourth ave., N. Y., exclusive American sales agents for its artificial silk products.

Threads from 70 to 300 dernier are manufactured by this company and are said to surpass in fineness those made by any other Belgian artificial silk manufacturer. It is said that other artificial silk concerns in this country cannot offer threads of less than 130 dernier in weight. The finer threads are in demand for artificial silk fabrics of finer grades than have been made heretofore in this country.

The dernier, as the unit of measure of the artificial silk filament is the quotient of the weight in grams of 450 metres divided by .05.

Control Methods in the Purchase and Sale of Chemicals

By Dr. F. W. Russe

General Purchasing Agent, Mallinckrodt Chemical Works

DURING the past six years the chemical industry of this country has undergone great expansion. This expansion was due to the privations no less than to the necessities of war. When greatly needed chemicals, not then manufactured in this country, could no longer be imported, it devolved upon the manufacturers already established to supply these needs, or upon others to promote entirely new enterprises for their manufacture.*

In either case there were serious handicaps. Skilled chemists out of employment were hard to find. Machinery necessary for manufacturing was most difficult to obtain, and, in many instances, the processes of manufacture were not known, or very imperfectly known. Thus, these new manufacturers were embarrassed by a lack of chemists, difficulty in obtaining apparatus, and imperfect knowledge of the processes of manufacture. That these difficulties were overcome we all know, and today the United States is independent of foreign manufacture. The length of the war and the slowness of the European recovery since the armistice have enabled the expansion to be placed on a strong financial basis.

Chemicals are manufactured for specific needs that are more or less wide in scope. Certain needs are standardized by law, as chemicals used in foods or medicine; others become standardized by the economics of manufacture relative to the uses of the chemicals. There is no such thing as chemically pure chemicals, commonly called C. P. chemicals. That term means that those chemicals contain a minimum of impurities as shown by the most delicate tests known, and in any case are far purer than the chemicals usually sold in commerce, and described as "industrial" or "technical." Moreover, chemicals may be regarded as pure if there is no foreign substance in them which in any way is detrimental to the particular use of the chemical. Thus, it frequently happens that the largest use determines the purity to which any chemical is manufactured and impurities that are innocuous to this main use are not eliminated. For instance, potash for soap making may have fairly large percentages of soda, chlorides and sulphates. Potash for glass-makers should contain considerably less of these impurities, and potash for the manufacture of medicinal chemicals should be free from soda and arsenic, but may contain a fractional percentage of chlorides and sulphates.

It is impractical to test every chemical manufactured or every chemical bought for all possible impurities, and practice has narrowed testing to the probable impurities that may be found. The tests applied are the



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Mallinckrodt Chemical Works

result of experience with that chemical. If a change has been made in the source of crude material or in the process of manufacture, it is quite probable that impurities may be present which are not detected by the test employed.

It is for this reason that manufacturers of chemicals and large users of chemicals must employ a means of safeguarding their purchases and production so that an undetected impurity, which later gives trouble, may be traced to its source and guarded against in the future.

The methods employed by the various manufacturers may be different in execution, but are approximately the same in principal and consist in placing an identification mark on each shipment received and on each batch manufactured. The following procedure works well on packaged goods and may be used on bulk goods if there are enough bins to keep separate the receipts or batches.

Receipt of Chemicals

On receipt of each shipment, the purchasing department or stores clerk notifies the purchasing department of the number and kind of containers, with the name they are labeled. Each name forms a separate report, preferably in duplicate. For instance, the reports would read "150 carboys Acid Sulphuric 66°"; or "50 casks Potassium Carbonate" or "50 kegs of Iodine"; to these reports are, of course, added all other marks or numbers appearing on the packages. The purchasing department recognizes the shipment as a whole or partial delivery of chemicals they had ordered, stamps the original and duplicate report with the same letter and number and immediately returns one copy to the receiving clerk, who stencils in large indelible figures that letter and number on each cask or carboy of the lot in question.

The letter is the same for all receipts of all chemicals in one year. If "A" is used for 1920, "B" may be used for 1921, "C" for 1922, etc. The number is serial; thus the first shipment received in 1920 would be A-1, the second A-2, etc. The shipments are numbered serially, irrespective of the kind of chemical received and the letter and number becomes an integral part of the name of the chemical. Each of the 150 carboys of acid sulphuric 66° mentioned above, for instance, might be marked "Acid Sulphuric 66° lot mark A-4962." Each of the casks of potassium carbonate might be marked "Potassium Carbonate lot mark A-4963," etc. If two shipments of the same chemical are received from the same or different sources at the same time, each should be kept separate and given its individual lot mark. After the receiving clerk has placed the lot mark on the package the shipment temporarily lies dead.

In the meantime the clerk in the purchasing depart-

*Presented at convention of National Association of Purchasing Agents, Chicago, October 11-13.

ment who has stamped the lot mark on the receiving clerk's report, types instructions on a standard form to the analytical department directing them to sample the 150 carboys Acid Sulphuric 66° lot mark A-4962 and test the sample for the grade for which the purchase is intended. This is done and the laboratory reports back the lot is O. K. The purchasing clerk at once notifies the receiving clerk that that particular lot is O. K. and the receiving clerk stencils O. K. behind the lot mark on each container. Thus, the official name for the 150 carboys in question is "Acid Sulphuric 66° lot mark A-4962 O. K." and are now free to be used.

No goods without the O. K. stamped on the container following the lot mark should be used in manufacture, or shipped, as the absence of the O. K. signifies that they have not been tested. Should the laboratory report the goods "Not O. K." then the purchasing department returns the shipment to the sender or makes other disposition of it. The purchasing department further completes its record by putting on each invoice and in its commodity record the lot mark covering the delivery of each chemical bought.

Production of Chemicals

The same procedure is used in chemicals produced, either by taking a different year letter for the manufactured articles or by using the same letter as bought goods and reserving a sufficient range of numbers from the purchasing list so that there will be no duplicates. As it frequently is convenient to deliver manufactured goods as rapidly as produced, two additional numbers are added to indicate the delivery. Thus, for instance, Potassium Iodide lot mark A-69701 is the first delivery and Potassium Iodide lot mark A-69713 is the thirteenth delivery for the given run A-697 of Potassium Iodide. As in bought goods, the factory office notifies the analytical laboratory that Potassium Iodide lot mark A-69713 is ready for sampling and testing, and when the laboratory reports the goods O. K. they are so stencilled and are ready to be used in other process or to be shipped.

Essentials of Accurate Records

The main points are:

1. No goods should be used or shipped unless the containers are stencilled O. K.

2. Every ticket, job sheet, transfer order, etc., that covers any chemical must contain the full name of that chemical, which includes the lot mark and the O. K. This should be followed religiously on every entry up to the final billing of the goods to the customer. To those who do not have to use such a system, this may seem cumbersome, but in reality, it soon becomes second nature and does not appreciably lengthen those chemical names. It is made necessary by the fact that it is impossible to test chemicals except for usual impurities.

An Example

Let us suppose that trouble is experienced in the manufacture of potassium sulphocarbolate. The analytical laboratory reports the presence of arsenic in certain lots. The job sheet shows the various chemicals used in the manufacture. From the lot marks of those chemicals the analytical laboratory refers to its reserve samples (samples are usually kept two years) of each of the particular lots used, and the source of the arsenic is located. If it is found that a bought item has caused the trouble, the purchasing department, from its records, can tell that the sulphuric acid bought August 18 from

John Smith contained more than the guaranteed amount of arsenic.

Similarly, if it is a manufactured article that has caused the trouble, it in turn may be traced back until the original source of the contamination is discovered.

The Consumer's Problem Solved

On the other hand, a customer may complain that a chemical he has purchased is behaving in an unsatisfactory way. If he reports the number on the barrel or the number in the corner of the label of the pound bottle or the ounce can, the reserve sample may be tested again and the complaint justified or proven wrong. The lot mark of itself is complete identification. It is never duplicated and the complete history of every manufactured chemical may be traced through each process to the several receipts of crude material from which it was manufactured.

Changed Conditions Enforce New Methods

During the war the manufacture of chemicals was forced and old sources of crude material were cut off. Since the armistice greater care is being exercised in the manufacture of goods, improved processes are being tried and competition is forcing greater attention to cheaper methods and new sources of crude material. All of these effect the quality of the finished product so that it is necessary for each large user of chemicals to adopt some system of safeguarding his purchases so that if anything goes wrong in their use he readily and surely may find the source of the trouble.

Chemical Club of Philadelphia

Representative chemical jobbers and manufacturers in Philadelphia held a second meeting at the City Club of that city on October 11, where was perfected the organization of the Chemical Club of Philadelphia. Weekly luncheons will be held for the purpose of getting together and forming closer business relations in the local chemical trade. Plans for the club indicate a determination to make for it a foremost place among similar trade organizations.

Industrial Notes

B. H. Adams, president of the American Linseed Oil Co., announces the change of the termination of the fiscal year of his company from Sept. 30 to Dec. 31, a change necessitated by the rapidly increasing preponderance of the edible oil products business over the linseed oil business. The American Linseed Oil Co., in 1917, acquired the Nucoa Butter Co., edible oil refiners and margarin manufacturers, the expansion of whose business now dominates the linseed oil business in the enterprise of the American Linseed Oil Co.

* * *

Maguire, Paterson & Palmer, Ltd., of Liverpool, England, will duplicate its English match factory at Garston, near Liverpool, in Canada, in co-operation with the Laurentide Pulp & Paper Co. The latter company, not using the sulphite process, will turn over to the match company the pine wood suitable only for pulp manufacture by this process. Five million dollars will be invested in the enterprise, which will be managed by a directorate of twelve, six of whom will be Canadians, headed by Mr. George Cahoon, president of the Laurentide Co.

* * *

National Candy Co. will erect a \$1,000,000 factory at Louisville, Ky.

The Issue of the Open Shop

An Example, a Decision, and the Attitude of Industry

By C. Wilbur Miller

President, Davison Chemical Co.

THE Atlantic Smelting & Refining Works, Inc., 57 Richards St., Brooklyn, N. Y., entered into a contract with the Lehigh Structural Steel Co. for the erection by the latter of the structural steel work of the former's new refining plant at Newark, N. J. The Lehigh Co. sublet the erection contract to the Donnell-Zane Co., 350 Broadway, N. Y. As the job approached completion, Tim Tierney, business agent of Local No. 11, International Brotherhood of Bridge and Iron Workers of America, called a strike.

On the declaration of the Donnell-Zane Co. to employ other available labor to complete its contract, William E. Lehman, architect, and representative of the Smelting Co., notified the sub-contractor that completion of the building with other than union labor would not be permitted because employment of non-union labor would result in a general strike of the allied trades on the job.

Efforts to effect an agreement failing, the Donnell-Zane Co. proceeded with the work until stopped by an order of the Court of Chancery obtained by the Smelting Co. upon the allegation that an agreement existed for the exclusive use of non-union labor. Evidence of such agreement not appearing, the Smelting Co.'s injunction was dissolved. Further effort of the Smelting Co. to effect a money settlement with the Donnell-Zane Co. failing, it notified the Lehigh Co. to stop all work under the contract.

The decision of Vice-Chancellor Backes to which prominence here is given, was handed down in the action of Donnell-Zane Co. against Lehman, the architect, the Atlantic Smelting & Refining Works, Inc., Tim Tierney, the business agent, and his union, to prevent the defendants or any of them from interfering with the Donnell-Zane Co.'s contract to build the smelting works at Newark.

In justification it was shown that the Building Trades Employers' Association of New York, of which the Lehigh Structural Steel Co. was a member, had entered into a contract with the New York Building Trades Council, binding the former to employ only union men. The Donnell-Zane Co. refused to recognize this agreement, claiming it was beyond the power of the Employers' Association to bind the league and its members by restricting them in the selection of their workmen.

Tierney and his union were not a party to this agree-

ment, nor a beneficiary, save in the sense that all locals may be benefited by the achievements of the various unions of the federation. Vice-Chancellor Backes declared the strike sought to be enjoined by the Donnell-Zane Co. a purely sympathetic strike. The general application of the principles he so clearly set forth is fundamental to the persistence of democratic government and the conduct of industry by those whose enterprise makes it possible.

Excerpts from Vice-Chancellor Backes' Decision

The men were not under contract and individually had the right to quit work as it pleased them, provided the motive—the object sought to be attained—was not an unlawful one.

But the privilege to strike is not license to strike. Those availing themselves of the privilege must respond in damages for the injury inflicted unless they can show just cause or excuse. The burden is on them.

It is plain that the primary and ultimate thing organized labor sought was the monopolization of labor in all lines of the building trade within the territory to which the contract applies. As to this there is no question, for counsel of the union frankly admits this indictment, and asserts that the movement to bring about the closed shop, not only in New York, but throughout the nation, is within the law.

The principle of the closed shop, namely, the monopolization of the labor market, has found no judicial sponsor. In whatever form organized labor has asserted it, whether to the injury of employer or to labor or to labor unions outside of the fold, the judiciary of the country has responded uniformly, that it is inimical to the freedom of the individual pursuit guaranteed by the fundamental law of the land and contravenes public policy.

On the other hand, public policy favors free competition, and the courts have been keen to recognize the right of organized labor to compete for work and wage, and economic and social betterment, and to use its weapon—the strike—to realize its lawful aspirations, but none has gone to the length of sanctioning a strike for a closed shop, which has for its object the exclusion from work of workmen who are not members of the organization.

The conclusion upon the case as presented is that the New York contract violates public policy, and that the sympathetic strike is without just cause or excuse and is unlawful.

Mr. Miller's Reply to Mr. Gompers' Attack on the Open Shop

The National Chamber of Commerce in its recent questionnaire which upheld overwhelmingly the "open shop" and its place in our jurisprudence as defined by Vice Chancellor Backes, aroused the animus of Samuel Gompers. Mr. Gompers assumes first that he, as President of the American Federation of Labor, represents and speaks for the working men of the United States, and, second, that all employers are only thinking of themselves in approaching questions relating to labor. There is not the slightest foundation for either assumption, and it is because Mr. Gompers spends part of his time with the American Federation of Labor officials, who make themselves believe these conditions exist, and the rest of his time trying to convince the politicians his assumptions are correct.

It makes very little difference what Mr. Gompers or his official family believes, but the American public and politicians should know that the American Federation of Labor only represents a very small minority of working men and many of the number are aliens without the suffrage. The em-

ployers who belong to the National Chamber of Commerce represent the majority of American working men, and when they vote for the "open shop" they cast the vote for this majority, as it is in this way they can be heard. If they did not vote for the "open shop" they would all belong to the American Federation of Labor and there would be no discussion on the subject.

Says Men Oppose Federation

Some months ago a committee of men from one of the plants I represent came to me with the complaint that the American Federation of Labor was turning the public against the working man, and that they felt it was time for the employers of non-union labor to defend

them and act as their spokesmen. Knowing that they threw into the bay a walking delegate who had the courage to enter our works to organize them, I sought their reasons for their strong opposition to the union. They were as follows:

First—They strongly objected to the tyranny and selfishness of the labor union leaders.

Second—They objected to being put upon the same level of less efficient or more indolent men.

Third—They were indignant at the strife and hard feeling being stirred up between employer and employee and the general branding of the employer as a scoundrel and discredited person. They knew most employers were once laboring men and they hoped to be themselves or were educating their children to be employers and had no intention of tearing down their goal.

Fourth—They felt the contact with the employer direct was more satisfactory and brought quicker and better results than through a medium which considered its own ends first and the men second.

Fifth—That men out of the union got better wages and were much more contented. They looked upon the employer as a friend and leader and enjoyed working with him, instead of begrudging every service, knowing nothing individually, counted.

Points to the Steel Strike

Mr. Gompers does not want to admit these facts. He found out in the steel strike a majority of the working men wanted an "open shop." He knows that his power has only come from augmenting governmental control by frightening the timid politician with his soap bubble.

Deflation and the Paper Industry

While many of the industrial companies are now confronted with large inventories which will necessarily have to be marked down this year, this will not be necessary among the paper companies.

On the contrary, wood and wood pulp, which are the chief items in their inventories, have enhanced in price over last year's quotations to an alarming degree and give every indication of going higher still. Wood pulp is now selling at \$140 a ton, the highest price in the history of the industry. There is a scarcity of this commodity and many of the paper companies, if they wished, could dispose of their stocks at prices representing considerable advances over what they paid for them.

Wood for paper making purposes is now selling at approximately \$34 a cord against \$21 a little more than a year ago. It continues scarce and higher prices this year or early in 1921 would not be surprising. This is explained in part by the fact that last year's cutting was below normal. Paper companies usually cut their wood at least a year in advance, so that they are now using timber which was cut last year.

Timber cutting operations are being restricted this year to a large extent by the inability to secure adequate labor. There is a growing disposition on the part of the men to seek less arduous forms of employment and despite exceptionally high wages it is difficult to obtain a sufficient force.

It would appear from first glance at the balance sheets of some of the large paper companies that they are carrying exceptionally large inventories for the amount of business transacted in a year. This is not so. The large stocks of raw materials carried as inventories have increased in price more than 100 per cent. in the last four years. Only a negligible portion of inventories

Mr. Gompers realized some time ago that the majority of working men were with their employers and that if they all worked together in political matters the union would be an empty shell. It was for this reason that legislation was constantly directed against the employed, to discredit him. Why cannot the politician remember the political contest between Mr. Bryan and Mr. Taft? Mr. Bryan accepted the plank on labor, or better labor unions, as written by Mr. Mitchell, and the A. F. of L. advocated his election, and yet Mr. Bryan got less votes than he ever received before.

Put a labor union plank in the platform of either party and the majority of laboring men will vote against that party.

The majority of working men, the majority of employers, the majority of salaried men, the majority of professional men and, I believe, the majority of union laboring men, if they could speak their minds, believe in an "open shop," and all these classes are just as interested in the betterment of mankind as a few men who make a living misrepresenting the laboring man and the country.

It is quite time that men representing the majority of men in this country who work with their hands and skill come to their defense. Most of the men employed at our works are my personal friends, and I represent them when I speak on this subject or vote at the National Chamber of Commerce. If I did not, they would choose Mr. Gompers by joining the union. They all know I voted for the "open shop" and they all back it up, as do the employees of the other members who voted the same way.

of the paper companies is represented by finished stocks on hand. This is explained by the fact that the pressing demand for paper practically clears out stocks as soon as manufactured.

International Paper Co., the largest American producer, at the close of 1919 showed inventories of \$23,713,388, against \$21,397,041 in 1918 and \$12,762,692 in 1917. The increase is accounted for in large measure by increased wood prices. The company could today dispose of its raw materials at higher prices than it paid for them. As an instance, the company is selling the finished product, newsprint, at \$130 a ton. The ton of paper is practically all wood pulp, together with added chemicals, and the pulp is selling at \$140 a ton, or \$10 over the selling price of the paper.

E. I. du Pont de Nemours & Co., Wilmington, Del., have completed plans for a new steam-operated power plant in the vicinity of Pine Grove, N. J., to cost about \$350,000, including equipment. The du Pont Engineering Co., du Pont Building, Wilmington, is in charge.

* * *

The Dunlop Tire & Rubber Corporation, River Road, Buffalo, N. Y., has arranged for the erection of an addition to its cord fabric plant at Utica, N. Y., to cost about \$80,000. It is understood that further additions will be made at a later date, with an available fund of \$2,500,000 to be used at Utica out of an appropriation of \$20,000,000 for the Buffalo plant, now in course of erection. The parent company, the Dunlop Rubber Co., Ltd., London, England, has recently trebled its capital, now approximating \$100,000,000. Perry D. Saylor is vice-president and general manager of the organization in the United States.

Cogitations on the Chemical Show

THE various scientific organizations in the chemical and allied industries have a legitimate place in their activities and are essential to record the progress of the art. In educative value and in social opportunity to all identified with the industry they are far outclassed by the Chemical Show.

What the visitor got out of it depended entirely upon what he brought to it, and upon what he was determined to get out of it. He found the business chemist essentially a teacher who knows that he can gain only insofar as he advances the interests of those to whom he sells.

To those exhibitors whose products are in closest touch with the tastes and demands of the ultimate consumer, and whose manufacture constitutes the newer chemical industry, ample opportunity was had to impress the visitor with the substantial attainments of American chemists in national independence in chemical manufacture.

The Chemical Exposition is an educational institution, not alone for the general public, which in the eyes of many exhibitors are an annoyance, but primarily for those who make their living in chemical manufacture and merchandising.

The chemical industry differs strikingly from other lines of manufacture in the inter-dependent inter-relations of the congeries of industries that comprise it.

Generally, it may be stated that outside of pharmaceuticals and a growing list of synthetic products, the products of the chemical industry reach the ultimate consumer only through the medium of the allied industries into whose products they enter as essential raw materials.

The esoteric character of chemistry lies in its seclusion from the beaten paths of the common things, yet it is the very soul of the market place, which only those who understand it know.

Passing from the soil to the consumers of the products created by the chemist, the exhibitors fall into the following five classes:

I. Development of natural resources of a nation, region, or a neighborhood.

II. Production of raw materials in their various degrees of refinement, the finished product of one industry being the raw material or an essential ingredient of the product of another.

III. Builders of equipment, tools and accessories for chemical manufacture.

IV. Educational enterprises of the chemical and allied industries.

V. Provision of service, or the sale of skill.

Among the nearly 500 exhibitors whose co-operation made the sixth National Exhibition of the Chemical Industries the most successful of the series, limitations of space permit the mention only of a few.

Alcohol and numerous allied chemicals derived in its production, a number of which never before have been produced in America, were exhibited by the **U. S. Industrial Alcohol Co.** and the **U. S. Industrial Chemical Co.**, 27 William street, New York, together with literature descriptive of their uses.

Merck & Co. made their customary exhibit of pharmaceuticals and "Blue Label" reagents.

New Jersey Zinc Co., the largest factor in the production of zinc and zinc compounds in America, showed the manufacturing trail pursued by zinc from ore to the finished product, with the by-pro-

ducts obtained en route. Zinc for permanence was illustrated by its use as a roofing material.

The world's largest and most completely equipped research laboratory devoted wholly to zinc is located at Palmerton, Pa. It is owned by the **New Jersey Zinc Company** and is operated both to develop new uses for that company's products and to render service to customers who desire to improve their manufacturing methods.

E. I. du Pont de Nemours & Co., had an educational booth wherein was illustrated by means of balls, the systematic confusion of the benzene group, and the ease of its molecular arrangement to form either dyestuffs or explosives. The display of the wide variety of chemical products made by this organization was supplemented by manufactured articles in which these products are used.

Electro Bleaching Gas Co., 18 East Forty-first street, New York, displayed liquid chlorine and its possibilities as a textile bleach. The convenience, dependability, cheapness and uniformity of results of liquid chlorine in textile manufacture over the historic commodity were illustrated by textiles bleached with this agent.

National Aniline & Chemical Co. had a brilliant display of American dyestuffs with their application illustrated by products whose desirability resides in their color. The intimate and varied contact of dyes with the ultimate consumer was shown by means of manikins placed in a setting in which every item of wear or decoration owed its attractiveness to American-made dyestuffs.

General Chemical Co., 25 Broad street, New York, one of the big five in the organization of the Allied Dye & Chemical Corporation, displayed the reagent chemicals of its fine chemical manufacturing department, the **Baker & Adamson Co.**, a model 70-ton sulphuric acid tank car, the product of its **Pulaski, Pa.**, foundry, the **Herreshoff** roasting furnace, and a collection of samples of its acids and other heavy chemicals.

Newark Wire Cloth Co., 224 Verona avenue, Newark, N. J., exhibited in operation a hand-loom for weaving centrifugal lining of monel metal, which hand-loom, while in operation in many wire plants, has been displaced in the exhibitor's plant by the automatic machine loom. Metal filter cloth and wire cloth for various industrial uses were shown.

Provost Engineering Co., 220 Broadway, N. Y. featured an improved mixer for chemicals, dyes and pharmaceuticals, provided with a detachable agitator, permitting easy cleaning, outside stuffing boxes, assuring tightness with little annoyance, and roller bearings, with minimum power requirements.

S. S. Hepworth Co., 2 Rector St., N. Y., showed in operation an electrically operated centrifugal which illustrated the simplicity and dependability of this device in its contribution to large output and low maintenance costs in the drying and filtration processes to which the centrifugal machine is adapted.

J. P. Devine Co., Buffalo, N. Y., in its installation of equipment with every appearance of permanency, showed in operation various types of chemical machinery of its manufacture embracing chamber dryers, vacuum drum dryers, vacuum pumps, the **KEK** mill, etc.

Geigy Co., Inc., 89 Barclay St., N. Y., selling

agents for the Swiss dye-makers, J. R. Geigy, S. A., of Basle, and its American manufacturing branch in Cincinnati, illustrated the various dyeing and printing operations of the textile industry wherein dyestuffs are used. This ingenious departure from the usual display of materials and the finished products was rewarded by marked attention and comment.

Hooker Electrochemical Co., 25 Pine St., N. Y., exhibited the electrolytic and other chemical products of its manufacture at Echota, N. Y., Prof. Victor Lehner's new commercial solvent, aluminum oxycchloride was shown; also antimony crimson and antimony golden in addition to chlorine and the alkalis derived from salt.

Beach-Russ Co., 220 Broadway, N. Y., exhibited its vacuum pumps, blowers and acid-resistant pumps. The degree of exhaustion possible by the use of the compound two-stage rotary vacuum pump was illustrated by the perfect illumination of a tungsten lamp exhausted direct to the pump. The acid pumps are made of hard lead and antimony and provided with a special stuffing box. A rotary pressure blower, with a glass front, showed in operation the absence of springs or gears.

United Filters Corp., 65 Broadway, N. Y., showed working models of the Kelly and Sweetland pressure filters, American continuous filters, the United filter press; also Sweetland's patent metallic filter cloth.

Chas. F. Garrigues Co., 54 Wall St., N. Y., exhibited its line of heavy chemicals and specialties, embracing a collection of Norwegian products and the steel drums of the Welden Steel Barrel Co., of which it is the sales agent.

Wm. Garrigue & Co., 154 Nassau St., N. Y., illustrated the Garrigue Chemical Service in the design construction and operation of plants in which the organization specializes, viz., fats and oils and their manufactured products in their various industrial branches.

Aniline Dyes & Chemicals, 134 Cedar St., N. Y., displayed a full line of cotton and sulphur dyes and of goods dyed and printed with the products of the Dow Chemical Co. and Robt. Gilchrist & Co., for which it is sales agents.

Vitreous Enameling Co., Cleveland, O., showed the wide availability of its enameled utensils in chemical manufacture by the display of pans and trays after two years' use for drying, evaporating and crystallizing, which illustrated vividly the durability of such vessels in handling corrosive materials.

Kewaunee Mfg. Co., Kewaunee, Wis., displayed the quality of its laboratory and technological furniture and its suitability in the equipment of every kind of laboratory in school, factory and hospital, and for the drafting room.

Zaremba Co., Buffalo, N. Y., exhibited the simplicity of the construction features, durability and efficiency of the Zaremba evaporator in various capacities, materials and effects for the concentration of any liquor. The well-known crystallizing types for the separation of precipitated matter without interruption of evaporation was illustrated.

A. Klipstein & Co., 644 Greenwich St., N. Y., had a varied and comprehensive display of chemicals used in the textile, paper, leather, paint and the allied chemical industries, embracing dyestuffs, softeners and finishing agents, tanning materials, dryers, egg products, gums, waxes, oils, etc., together with articles into which these products enter.

Swenson Evaporator Co., Chicago, Ill., by use of model evaporators demonstrated the availability of the Swenson type for industrial evaporation in the production of a wide range of commodities.

Fowler Bottling Machine Co., 124 White St., N. Y., displayed its filling machines, adapted to a wide variety of chemical products and for any style of container. Cylinder strainers, emulsionizers and the Fowler collapsible tube machine also were shown.

Abbe Engineering Co., 224 Broadway, N. Y., displayed laboratory and plant porcelain jar and pebble mills, shredders and disintegrators in various capacities.

Christian Becker, Inc., 92 Reade St., N. Y., exhibited models of their more popular analytical and laboratory balances, No. 8A. Analytical and specific gravity chainomatic balance were shown, as well as various styles of torsion balances. A 2,000-ounce bullion scale attracted much attention.

Eimer & Amend, New York City, displayed many interesting items of their industrial and educational laboratory apparatus among which were autoclave, calorimeter, stills, furnaces, emulsifier, hot plates, microscopes, ovens, viscosimeters, porcelain, glassware and blown glass apparatus.

American-La France Fire Engine Co., Safety Devices Division, Elmira, N. Y., had a complete and interesting display of safety appliances, including masks for all gas and dust conditions, pure air apparatus, safety goggles, first-aid cabinets and warning signs. The La France-Yablick mask, for use under strong ammonia fumes, such as encountered in refrigerating plants, etc., was demonstrated.

Detroit Range Boiler and Steel Barrell Co., Detroit, Mich., showed its response to the demand in the chemical industries for a metal container with or without a detachable head, possessing the easy handling qualities of the wood barrel, by the display of its "Perfect" metal bilge barrels and "Detroit" drums.

F. J. Stokes Machine Co., Philadelphia, Pa., exhibited vacuum dryers and stills, condensers, powder-filling and tablet-compressing machines, together with a display of tablets of great variety of shapes and sizes produced with its equipment.

Sarco Co., Inc., Woolworth Bldg., New York, displayed steam traps, temperature regulators, CO₂ recorders and recording gas calorimeters, and featured the simplicity of the Sarco steam trap and the reliability of its temperature regulators for chemical manufacturing operations.

General Ceramics Co., 50 Church St., N. Y., in its exhibit of acid and chemical resistant stoneware displayed in faultless operation a model hydrochloric acid plant whose product is dependent upon the use of this material. All standard chemical stoneware was illustrated by models indicating the variety of uses demanded of this material. The fused silica products of this company were shown in dishes, pipes, retorts and trays used in laboratory and plant operations.

F. C. Huyck & Sons, Albany, N. Y., illustrated the use of woollen filters cloth in many filtration processes of great importance in chemical manufacture from the plate filter press to bag filtration and dust collection. Their cloths for filtration, by adaptation to specific needs in the chemical industries, have become standardized for the various process requirements.

Leeds and Northrup Co., Philadelphia, featured

the following instruments: Automatic Hydrogen Ion Recorder and Controller, for regulating the amounts of reagent in an acid-base reaction; Automatic Electrolytic Conductivity Recorder, producing a graphic record of concentration of an electrolyte in solution; Bovie Hydrogen Ion Potentiometer, for plotting curves in hydrogen ion titrations; temperature measuring apparatus, including recording, signalling and controlling pyrometers operating on the potentiometer principle; optical pyrometer, and apparatus for determining transformation points of steel; Hump Method for heat treatment of steel.

D. Van Nostrand Co., 8 Warren St., N. Y., displayed publications showing its intimate contact with chemical development in America and its service as publishers and book-sellers to American industry for three generations. Dr. Allen Rogers' "Manual of Industrial Chemistry" was featured.

Maurice A. Knight displayed an assortment of chemical stoneware equipment, diverted in shipment to consignees, which indicated the variety in capacity, shape and purpose, serviceability and quality,

of the acid and chemically resistant products of the potter's art which have played an essential part in the development of chemical manufacture.

American Hard Rubber Co. featured the latest developments in the use of hard rubber in facilities for the factory transport and storage of corrosive material. A 250-gal. steel tank lined with hard rubber illustrated the desirable combination of the strength of steel with the anti-corrosive properties of hard rubber in a non-contaminating storage vessel. Pumps, centrifugal and single-acting, pipe fittings, containers, tools, etc., showed the versatility of hard rubber in meeting the exacting requirements in the handling of corrosive liquids.

Thermo Electric Instrument Co., Newark, N. J., displayed various forms of constant temperature ovens, incubators and water baths, with automatic constant temperature control.

Union Sulphur Co., 17 Battery Pl., N. Y., attempted no display of its product but devoted its attention to the hospitable entertainment of its customers and friends.

Pennsylvania Salt Mfg. Co.

Joseph Moore, Jr., president of the Pennsylvania Salt Manufacturing Co., Philadelphia, Pa., in the seventieth annual report of his company, presents a summary of the activities of this successful organization, which reflects to a large degree the conditions in the general chemical field during the period noted.

The year opened July 1, 1919, with a gradually improving demand for our products. The previous six months had been the dulllest since 1914, and earnings presented corresponding results. This revival was partially checked by the steel and coal strikes. Our mines at Natrona helped us materially in the emergency.

Through the late fall and winter the expansion of trade assumed much larger proportions and prices began to advance. In some lines the former excessive supplies were converted into shortages. Embargoes and freight congestion crippled production and seriously reduced shipments, both of incoming and outgoing materials.

The earnings indicate what might have been the return without the extreme impediments which prevailed. Sales were \$8,289,164 as compared with \$8,088,918 for the previous twelve months. While unskilled labor has not been as efficient as soaring wages should inspire, the relations with all employees have been cordial.

New construction and improvements involved an expenditure of \$564,021 and for repairs \$670,569. The new alum plant at Philadelphia proved most opportune, the demand being up to capacity. The modern turbine engines at Wyandotte reduced appreciably the expense of power.

Our lye business has been notable throughout the country. A third acid barge has been ordered to insure ample delivery facilities. The important alumina process at Natrona, inactive for two years through inability to procure French bauxite, is now driven to the utmost, consuming recent cargoes. The porous alum department at Natrona will be extended to provide for growing distribution. Krvoľith has been so prominent in the year's sales that charters were concluded to bring an enlarged supply from Greenland.

Our research experts have been vigorously en-

gaged in perfecting new products, utilizing elements arising out of existing operations. One unit will occupy the building erected for the production of war gas. These additions promise excellent results. Others are in the experimental stage.

Mathieson Alkali Works, Inc.

In his report for the fiscal year ending June 30, 1920, President E. M. Allen says that, although there was a large demand for our products, the earnings were materially affected by the fact that, before the company began selling on its own account, a large tonnage had been sold at low prices for delivery during 1920. These low priced contracts will also affect the earnings for the last half of this year.

The company has established district sales offices in favorable localities and, as a member of the U. S. Alkali Export Association (organized under the Webb-Pomerene Act by the large alkali manufacturers of the United States), has experienced material benefits therefrom in connection with export business.

The physical condition of the Saltville, W. Va., works has been gradually improved, increasing the productive capacity and decreasing costs of production. The main boiler plant is being replaced by a modern plant of 10 large size standard boilers, three of which will be operating during 1920 and the remainder during 1921. The output is now limited by boiler capacity.

The Niagara Falls works suffered in February from impurities in the salt used for electrolysis. The installation of a brine filtration system will be entirely completed by October 20, when the works will be back to full capacity. Research laboratory has been established at the Niagara Falls plant for development work.

The company has materially strengthened its position in the past year as regards supplies of raw materials for years ahead, and plans have been made for further acquisitions. Our labor troubles having now been adjusted in a manner fair to our men we hope to minimize labor problems in the future, and continue all our works as open shops. The number of stockholders is now 873.

Personal Items

J. S. Carlitz, consulting and analytical chemist, 159 N. Second Street, Philadelphia, has opened a branch office at 276 Seventh Avenue, New York.

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J. L. Polk, formerly chemist with the New York Central R. R. Co., at Albany, N. Y., is now superintendent of the American Coconut Butter Co., Chicago, Ill.

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Zoltan de Horvath, formerly with Harrison Bros., Inc., Philadelphia, Pa., is now chief chemist, Midland Chemical Co., Argo, Ill.

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G. G. Lewis has resigned as district chemist of the Buckeye Cotton Oil Co., at Little Rock, Ark., to become president of the Little Rock Laboratories, Inc.

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Felix P. Lockwood, formerly with the drug department of W. R. Grace & Co., is now with Unger & Co., 30 Pine Street, New York, as assistant manager of the drug and chemical division.

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Yoshio Nitobe, of the Philadelphia Quartz Co., Philadelphia, Pa., has sailed for Japan where he will be in charge of the company's recently established sales branch at Tokio.

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C. F. Hackedorn, for a number of years chief chemist of the Armour Fertilizer Works and later identified with manufacturing direction, has been elected vice-president and a member of the board of directors.

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F. E. Ford, in charge of the export sales department of the Warner Chemical Co., electrolytic cell division, 52 Vanderbilt Avenue, New York, has sailed for Europe on a business trip of several months' duration.

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Recent additions to the chemical staff of the Calco Chemical Co., Bound Brook, N. J., comprise M. C. White, formerly of the Delta Laboratories of the Du Ponts, and W. K. Pritchard, Jr., of Atlanta, Ga.

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I. V. Maurer, manager of the soda ash manufacturing department, and Roy L. Barnes, of the engineering department of the Solvay Process Co., have sailed for a nine-months European technical reconnaissance.

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J. F. Mitchell-Roberts will represent the Oliver Continuous Filter Co., 33 West 42d Street, New York, and 503 Market Street, San Francisco, Cal., at its newly established office at 2 Broad Street Place, London, E. C. 2, England.

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C. E. Pimbley, former chemist in the paint department of the Illinois Steel Co. and latterly chief chemist at the Heath and Milligan plant of the Glidden Co., is now chemist for the Standard Textile Products Co., Rock Island, Ill.

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E. Daniel Fisher, formerly with the American Aniline Products Co., is now sales agent at 152 Front Street, New York, for the Texdel Chemical Co., Jersey City, N. J., manufacturers of food colors, pharmaceutical and textile specialties.

* * *

Dr. A. B. Lamb has retired as head of the Fixed Nitrogen Research Laboratory of the Ordnance Department, American University, Washington, D. C., to re-

sume his work at Harvard University. He is succeeded by his assistant, Dr. R. C. Tolman.

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Ivan D. Hagar, formerly chief chemist of the Mound City Paint and Varnish Division of the Certainteed Products Corp., St. Louis, Mo., and latterly sales engineer with the N. J. Zinc Co., is now production engineer at the Brooklyn plant of the Devoe & Reynolds Co., Inc., 101 Fulton Street, New York.

* * *

Dr. E. F. Northrup has resigned his professorship at Princeton University in order to devote his entire time to his work with the Ajax Electrothermic Corporation, Trenton, N. J. He was recently elected vice-president of the company and is now engaged in perfecting a brass-melting furnace of the Ajax-Northrup type.

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Dr. J. M. Johlin, director of the organic department of the laboratory of the Solvay Process Co., Francis Ware, chemist, and Byran W. Grimes, secretary to chief chemist Dr. L. C. Jones, have been elected respectively president, national councillor and secretary of the Syracuse section of the American Chemical Society.

* * *

Dr. Robert P. Fischelis, of Philadelphia, Pa., has opened an office for consulting chemical practice at 280 Madison Avenue, New York, and will specialize in the preparation of commercial literature for the chemical and allied industries. In the application of chemical knowledge to the marketing of chemical products by the printed word, Dr. Fischelis' work represents a new professional activity for the chemist.

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H. G. Ruhm, for several years in charge of the chemical department of Marden, Orth & Hastings Co., Inc., 136 Liberty Street, New York, has engaged in the chemical business on his own account at the same address. He is president of the Ruhm Phosphate Co., Mt. Pleasant, Tenn. Mr. Ruhm is a loyal Tennessean, being president of the Alumni Association of Vanderbilt University and vice-president of the Tennessee Association of New York.

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Messrs. Meigs, Bassett & Slaughter, Philadelphia, Pa., are the engineers for the Tubize Artificial Silk Co. of America. These gentlemen constitute the engineering staff of Samuel P. Sadler & Sons, Inc., 210 South 13th St., Philadelphia, Pa. Emile Bindschidler, 487 Broadway, New York, is manager of the company. A. Everarts, general manager of the parent Belgium company, is in charge of construction at Hopewell, Va., where it is planned to inaugurate artificial silk manufacture by January 1.

* * *

The general increased demand for chemical instruction is met in the Department of Chemistry of the College of the City of New York by the addition of the following men to the departmental staff:

Wyly McG. Billing, B.S., Alabama Polytechnic Inst., 1916, M.A., Columbia University, 1920; Harry P. Coats, B.S., Hobart College, 1917, M.A., Columbia University, 1918; Alexander Cohen, B.A., College City of New York; Alexander C. Glennie, Columbia University, 1916; Nathan Hecht, Senior Assistant, College City of New York, and Foster D. Snell, B.S., Colgate University, 1919.

Industrial Notes

The Illinois Glass Co. will erect at Bridgeton, N. J., a \$3,500,000 glass factory.

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Superior Enamel Products Co., F. L. Jaeger, vice-president and manager, St. Louis, Mo., will erect a 2-story 106 x 120 addition, costing \$60,000.

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The Capital City Products Co., margarin manufacturers, Columbus, Ohio, will enlarge its plant by a 2-story 100 x 165 addition, costing \$100,000.

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The Fort Wayne Corrugated Paper Co., Hartford City, Ind., has awarded contract to G. W. Heinzmann & Sons, Marion, Ind., for an addition to cost \$200,000.

* * *

The United States Corrugated Fiber Box Co., Indianapolis, Ind., will build a new four-story plant, 100 x 160, to cost about \$125,000, including equipment.

* * *

The Laundrymen's National Association will build a \$500,000 structure in Chicago to house its headquarters. It will be known as the Institute of American Laundering.

* * *

The Canada Cement Co., Port Colborne, Ont., has completed the installation of a potash recovery plant which will provide an estimated daily recovery of 7,000 pounds.

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The B. F. Goodrich Co., Akron, O., will confine their export shipments, aggregating \$20,000,000 per year, to the port of Baltimore, where warehouses will be built.

* * *

The National Cement Co., George E. Nicholom, president, Kansas City, Mo., will remodel and enlarge its Portland cement plant at Ragland, Ala., to a daily production of 2,500 barrels.

* * *

The project of the Tubiza Artificial Silk Co. at Hopewell, Va., embraces the purchase of 250 acres of land, 350 houses and seven dormitories. The mill structure will be of brick and steel, 286 x 600 feet. Capitalization is \$5,000,000.

* * *

T. E. O'Reilly, Ltd., Toronto, Canada, formerly Canadian representative of the National Aniline & Chemical Co., now has the exclusive distribution of the artificial food colors of the Darwin Chemical Co., Elizabeth, N. J.

* * *

The Wheeler Condenser & Engineering Co., Carteret, N. J., manufacturer of steam condensers, pumps, engines, etc., has increased its capital to \$1,500,000 preferred stock and 10,000 shares of common stock, no par value.

* * *

Rumford Chemical Works Co., Providence, R. I., has acquired the Layton Pure Food Co., baking powder manufacturers, East St. Louis, Mo.; consideration \$700,000; possession October 1. H. P. Layton, formerly president, will remain as manager.

* * *

Swedish hopes for an independent dye industry have disappeared in the demise of the Swedish Dyestuffs Co. of Stockholm, which enjoyed a brief spell of prosperity while the German dye plants were devoted to munitions manufacture.

The Merrimac Chemical Co., Boston, Mass., in addition to its regular quarterly dividend of 2½ per cent., has declared an extra dividend of 4 per cent. on its outstanding capital stock, \$3,528,000, par \$50, both dividends payable September 30.

* * *

The Wimmer Construction Co., St. Louis, Mo., will erect for the Eagle Picher Lead Co., St. Louis, Mo., a \$600,000 plant. The Monsanto Chemical Works, St. Louis, also has awarded it the contract for the erection of seven plant structures costing \$400,000.

* * *

John E. Thayer, Jr., and associates, of Boston, Mass., have organized the Sagamore Corporation to develop a process for the manufacture of paper pulp from pitch pine, and will build an experimental plant at Sandwich, Mass., working first on the pitch pine of the local sand dunes.

* * *

R. L. Ray, president of the Rex Oil and Refining Co., and J. G. Bullock, Fort Worth, Texas, and E. P. Dillman, A. G. Wright and J. C. Rud, Dallas, Texas, have organized the Fort Worth Acid Works, capital \$50,000, to recover sulphuric acid from the acid sludge waste of local oil refineries. The material will be collected in tank cars.

* * *

Champion Fibre Co., pulp manufacturers, Canton, N. C., will build mills for book-paper manufacture, including additions to existing plant, costing several millions, and housing accommodations for 2,200 additional employees.

* * *

The American Institute of Fertilizer Chemists, in its program to correct trade abuses, to compensate for increased costs and to standardize practice in commercial analytical work, has advanced prices for analyses of fertilizer materials and abolished discounts to brokers.

* * *

F. S. Royster Guano Co., Norfolk, Va., has purchased the Jefferson Fertilizer Co., Birmingham, Ala., and will operate under the name of the Jefferson Agricultural Chemical Corporation. The plant, located near Bessemer, Ala., embraces 20 acres with a complete sulphuric acid installation and fertilizer plant.

* * *

Suzuki & Co., Kobe, Japan, have acquired from the Cumberland Coal, Power & Chemical, Ltd., which owns the British and colonial patents of the Claude process of nitrogen fixation, the exclusive Japanese rights to the patents, and will organize a company for their exploitation.

* * *

Trinity Paper Mills, 401 Marvin Bldg., Dallas, Texas, capital \$1,000,000, has been organized to build a plant for the manufacture of paper pulp from cotton linters, with initial daily pulp capacity of 20 tons. The company plans the erection of three mills in Texas and the ultimate utilization of the pulp in paper manufacture.

* * *

F. H. Appleton & Son, Inc., Franklin, Mass., manufacturer of rubber products, has changed its name to the Appleton Rubber Co. It is planning for general expansion and has acquired about 30 acres in the vicinity of its plant, a portion of the land to be used for a housing development. Francis H. Appleton is president, and Francis H. Appleton, Jr., treas. and gen. mgr.

The Kansas City Packing Box Co., Kansas City, Mo., with a wood pulp plant at Bogalusa, La., will erect an additional plant at Bastrop, La.

* * *

Titanium oxide for use as a paint pigment heretofore has been a Swedish product. The Titanium Products Co., Niagara Falls, N. Y., a subsidiary of the National Lead Co., is engaged in its manufacture in this country.

* * *

United States Glass Co., Morgantown, W. Va., will build a \$1,000,000 sheet glass plant at Shreveport, La., as an addition to its series of glass factories in the gas-producing districts.

* * *

Alabama graphite refiners have joined the peanut growers in their demand for a protective tariff. They claim that the Madagascar and Ceylon product can be laid down in New York cheaper than the domestic product.

* * *

Southern States Packing Co., B. F. Williamson, vice-president, will establish at Savannah, Ga., a meat packing plant, costing, with site, \$1,000,000, and embracing lard compound, cooking oil and soap manufacturing departments.

* * *

The daily maltose syrup production of the Baltimore Pearl Hominy Co., Dr. A. W. Smith, chemist, which is a subsidiary of the General Food Products Co., 501 5th avenue, N. Y., is announced as 25 barrels, with prospects of an early increase to 100 barrels.

* * *

The Borden Co., milk and milk products, 108 Hudson St., New York, has donated \$10,000 additional to Columbia University for research in food chemistry and nutrition under the direction of Prof. Henry C. Sherman.

* * *

United States Gypsum Co., Chicago, Ill., has begun the construction of a plant at Sweetwater, Tenn., for the manufacture of its products, which will represent an investment of \$1,000,000. Plans also call for the construction of a paper mill.

* * *

The United Fiber & Products Co., William T. Larkin, president, 1520 Fidelity Building, Baltimore, Md., will add about \$300,000 worth of new equipment to the plant acquired from the Sugar Cane By-products Co., New Iberia, La., for the manufacture of paper.

* * *

The Davison Chemical Co., fertilizer manufacturers, Baltimore, Md., will maintain a monthly barge service for the transportation of Cuban pyrites to its Curtis Bay, Md., plant. Two barges, 28 feet long and of 4,000 tons capacity, will be in the service.

* * *

Bruno C. Lechler, formerly general manager of the S. S. Hepworth Company and widely known as a builder of group centrifugals as used on sugar and allied products, is now associated with the Fletcher Works of Philadelphia, which will add to its output of chemical and textile centrifugals this type of equipment.

* * *

Butterworth-Judson Corporation, Newark, N. J., are pushing rapidly construction of its new para-nitraniline plant to replace that destroyed by a recent fire. Resumption of production is expected in December in what is claimed will be the most up-to-date and complete plant of its kind.

The International Nickel Co., 43 Exchange Place, New York, has acquired at Huntington, W. Va., a 75-acre tract on which will be expended several millions in the construction of a 3-unit plant for rolling monel metal rods and sheets. Frank I. Ellis, 2126 Farmers' Bank Bldg., Pittsburgh, Pa., is associated with W. L. Wotherspoon, the company's consulting engineer, in the selection of machinery and equipment.

* * *

The Compressed Carbonic Co., capital \$1,020,000, has been organized to utilize the carbon dioxide obtained as a waste product in the manufacturing processes of the U. S. Industrial Alcohol Co. The plant will be located at tide water in the Curtis Bay section of Baltimore, Md. The officers of the company are: President, A. R. Ludlow, vice-president, of the Air Reduction Co.; vice-president and general manager, George B. Cowper, both of New York.

* * *

The Lybeck Ocean Harvester Co. has been organized by N. A. Lybeck, 131 W. 36th street New York, to build at Lybeck, near Jacksonville, Fla., a tannery with a daily capacity of 1,000 shark and porpoise hides to utilize the catch of its ocean harvester, a 100-ft., 3-deck boat of 50 ft. beam. This craft, cruising at 6 miles an hour, will scoop up the fish by means of a device attached to the prow. Mr. Lybeck is located at Jacksonville, Fla., as president and manager of the enterprise which embraces an industrial development on a 200-acre tract and the building of ocean-going scoopers of a size to permit the skinning and by-product recovery of the catch while at sea.

* * *

The enterprise of the American Cotton Oil Co., Southern Cotton Oil Co., and the East St. Louis Cotton Oil Co. at Hopewell, Va., known as the Stamsocott Co., organized to utilize the lint refuse of cotton oil mills in the southeast, is at present employing 300 men in the operation of one digester unit in the daily production of 50 tons of paper pulp. J. W. Stull of Hopewell, is president and general manager. George W. Haskell, chief engineer of the Southern Cotton Oil Co., Savannah, Ga., is chief engineer; K. B. Lamb of the American Cotton Oil Co., is vice-president, and F. L. Palmer of the Southern Cotton Oil Co., is secretary-treasurer, both of New York. The utilization of second grade cotton and cotton-bulb fibre is the project of several recently organized corporations in the Cotton Belt.

* * *

General Electric Co. has acquired a controlling interest in the x-ray business of the Victor Electric Corporation of Chicago, and a new company has been formed, to be known as the Victor X-Ray Corporation, with offices and manufacturing plant in Chicago. Capital stock of the new company has been exchanged for General Electric x-ray patents and good will, and for the assets of the old Victor Electric Corporation.

Formation of the new company will result in full manufacturing, engineering and research co-operation between General Electric and Victor X-Ray. In 1914 General Electric placed the Coolidge x-ray tube on the market, and will continue to manufacture this invention and other devices used in the medical and dental professions.

C. F. Samms, president of the old Victor Corporation, becomes president of the new company. Dr. Coolidge, inventor of General Electric's x-ray tube, will be consulting engineer.

Florida Brewing Co., Tampa, Fla., will remodel its brewery to manufacture malt beverage.

* * *

Japan is now manufacturing most of the heavy chemicals required for industrial use, and in many of them taking her place as a competitor in foreign markets. Those which are not yet made there in sufficient quantity to meet the domestic demand include 60 per cent. caustic soda, glycerine, salicylic acid, yellow phosphorus, formaldehyde, aniline salt, acetate of lime, sulphate of ammonia and carbolic acid. Japan is destined to become self-supporting in most heavy chemicals and an important factor to be reckoned with in foreign markets.

* * *

Sandoz Chemical Works, Inc., 238 Water Street, New York, and 12 South Front Street, Philadelphia, has taken over the aniline color department of F. Bredt & Co., of the same address, where the latter company will continue as chemical manufacturers, importers and commission merchants. Sandoz Chemical Works, Inc., are the selling agents of the Sandoz Chemical Works, Basle, Switzerland, and of the American manufacturing unit of the Swiss combine, the Cincinatti Chemical Works, Inc., at Norwood and St. Bernard, Ohio.

* * *

The Signal Mountain Portland Cement Co., Chattanooga, Tenn., capital \$6,000,000, has been incorporated by Tennessee capitalists headed by R. C. Lubiens, a cement manufacturer of Stangar, Iowa. The company has acquired an advantageous site five miles from Chattanooga together with 600 acres of limestone land and will erect a plant with initial daily capacity of 3,000 bbls., to be increased to 5,000 bbls. George P. Deickmann, of the Gulf States Portland Cement Co., Demopolis, Ala., will be manager.

* * *

The James T. Pyle & Sons' plant, formerly used for the manufacture of soap powder, the trade mark of which was acquired by the Procter & Gamble Co., was purchased by the American Can Co. and used by it during hostilities on war contracts. The Lever Bros. Co. interests have purchased the property from the American Can Co., thus giving this world-wide organization a tidewater manufacturing plant and site in New York harbor.

* * *

The growth of exports of canned milk was one of the marvels of war-time trade. Demobilization, recovery of European dairy industry, and reduced ability to buy because of unfavorable exchange, have backed-up domestic supplies equal to half the national consumption. The closing of condensed and evaporated milk plants will make necessary the utilization of the product for butter and cheese for which the market is never saturated.

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The Association of Official Agricultural Chemists

By Hermann C. Lythgoe

Director, Division of Food and Drugs, Massachusetts Department of Public Health.
President, Association of Official Agricultural Chemists, 1920.

THE Association of Official Agricultural Chemists is one of the most unique organizations in this country. It consists of chemists engaged in making official analyses of soils, fertilizers and agricultural products, such chemists being connected with the U. S. Department of Agriculture, U. S. Internal Revenue Department, U. S. Bureau of Standards, State Agricultural Experiment Stations and State Food and Drug Control Departments. The work of the association is devoted exclusively to accuracy in chemical analysis.

Origin

The Association was organized as the result of variations in the analyses of samples examined by different chemists; there was no uniformity in results, no uniformity in methods, and more or less litigation between buyers and sellers. The organization was started through the efforts of Hon. T. J. Henderson, Commissioner of Agriculture of Georgia, and Mr. H. J. Redding of Georgia. (*Journal of the A. O. A. C.*, Vol. 3, 240) and three conventions or meetings were held in 1880 and 1881 to consider methods for the analysis of fertilizers, at which meeting both commercial and official chemists were interested.

Of these meetings Dr. Wiley stated, "After the adjournment of the Cincinnati meeting the interest in the collaboration of the agricultural chemists seemed to die out. There was a certain feeling of antipathy—perhaps it is not well to make it so strong as this, but a strong feeling of incongruity existed—between the trade chemists on the one hand and the official chemists on the other. It was an unvoiced sentiment pervading the organization to the effect that an association composed of trade chemists and official chemists contained elements of instability which would prevent it from ever becoming highly useful."



HERMANN C. LYTSGOE
Director, Division of Food and Drugs,
Massachusetts Department of Public
Health. President, Association of
Official Agricultural Chemists, 1920

After three years Mr. Henderson again called a meeting at Atlanta, Georgia, in May, 1884, which was preliminary to the formation of the present organization. The Association was formally organized in September of the same year at the Philadelphia meeting of the American Association for the Advancement of Science. The Association first took up the study of fertilizer analysis; then followed studies upon soils, cattle foods, dairy products and other materials connected with the agricultural industry; then fermented liquor and sugar were added to the list of subjects to be studied. The Association therefore officially investigated the subject of food for our crops, then of food for our animals, and lastly of food for ourselves and paradoxical as it appears the Association took the only logical mode of procedure. For this historical summary of the Association I am indebted to the presidential address of R. N. Brackett of Georgia before the Association November 21, 1915.

Economic Aspects

To the average so-called practical man it is of little interest whether an article contains 84.6 per cent. or 84.9 per cent. or even 85.5 per cent. of a certain substance, and for practical

purposes this statement is true in many instances. If, however, we consider these figures as representing the analyses of representative samples of a cargo of raw sugar where the buyer obtains the lowest figure by his analysis and the seller obtains the highest figure it is evident that the difference between these analyses would represent a substantial sum of money as to the price to be paid for the cargo. In a similar manner, slight variations between analyses of fertilizing materials are responsible for considerable litigation.

Development of Analytical Methods

The Association endeavors to produce analytical methods which will be first, accurate; second, rapid; third, as nearly "fool-proof" as possible. The study of these methods is carried out through referees and associate referees of which there are about sixty, each of whom studies for one year a particular method or several special methods applicable to one substance. These methods are then tried out by different chemists in different laboratories upon portions of the same sample except where such procedures are impracticable owing to the perishable nature of certain articles. The work under those circumstances, of course, is done upon different samples.

The referee receives the results of his collaborators, tabulates these results and presents them with his own comments and the comments of his collaborators at the annual meeting of the society and makes suggestions as to the procedure of the society relative to adopting the methods. His recommendations go to one of the three committees on recommendations of referees. The committee considers the proposed methods and the results reported by the referee, the referee being generally present with the committee at this conference. The committee then reports to the association recommending definite action upon the methods submitted. It is only after repeated work covering a period of two or more years, during which time all the collaborators obtain substantially the same results upon portions of the same samples, can a method take its place among the official methods of the association. Owing to this conservative policy it is very seldom that a method once made official is discarded or eliminated unless a new method is discovered which will give as accurate results by a simpler procedure or with less manipulation.

Application of the Association's Work

The application of these methods may be generalized as follows:

- (1) Alcohol: U. S. Internal Revenue Tax; Enforcement of Liquor Laws.
- (2) Sugar: Import Duties.
- (3) Soil: Experimental work upon soil necessities.
- (4) Fertilizers: Experimental work upon soil necessities and plant growth.
- (5) Cattle food: Experimental work upon plant growth and animal metabolism.
- (6) Dairy products: Experimental work upon cattle feedings; Milk products; Human metabolism; Infant feeding.
- (7) Food products: Manufacturers' control of food products, as well as human metabolism.

Law Enforcement

In addition to these uses, the methods relating to fertilizers, cattle food, dairy products and food products are used in the enforcement of the laws relating to the sale and the adulteration of the articles in question.

Whenever methods are needed for certain lines of work special studies are made and when the work is completed such studies may cease. The association aims to be strictly up-to-date. At the last meeting the referee upon distilled liquors was dropped and in his place was appointed a referee upon the limit of accuracy in the determination of alcohol in beers. The reason for this action is obvious.

Annual Meeting

The conventions of this association are distinctly different from other conventions. They are held annually, usually in Washington, D. C., and last for a period of three days. The entire time is consumed in discussing

the details of the various analytical methods studied. Papers from commercial men and from members of the association are occasionally presented when they are pertinent to the subject under discussion. There are practically no excursions and no organized sociability.

Personnel

The personnel of the members and past members may be of interest. As soon as a person leaves his official position he ceases to be an active member of the association, although most of such men generally attend the meetings. Those who have left their public work and gone with commercial houses are now engaged in the industries relating to baking, canning, meat packing, baking powder, manufacturing pharmacy, sugar, oil milling, dairying, fertilizers, cement, chemical manufacturing and journalistic work.

One of the members of the association, Dr. E. H. Ladd, of North Dakota, will have the honor of sitting in the next United States Senate.

Dr. Ladd thus confers not only upon the Association of Official Agricultural Chemists, but upon the chemical profession a unique distinction, for this political honor is the highest yet bestowed upon a practitioner of the chemical profession.

The active members of the association embrace the scientific forces of the United States Department of Agriculture and other related United States officials, presidents of agricultural colleges, directors of agricultural experiment stations, instructors in agricultural colleges, chemists in experiment stations engaged in experimental and analytical work relating to soils, fertilizers, human and animal metabolism, fertilizer control work, cattle feed control work, officials enforcing the food and drug laws, chemists engaged in food and drug control work and persons studying dairy chemistry.

Vocations of Members

The actual work of these men consist: I. In educating farmers to improve their soil conditions by the proper application of the right fertilizers; to improve their live stock by proper feeding, and to improve the food supply by proper study of agricultural production.

II. In enforcing laws relating to the sale of fertilizers, cattle feed, as well as food and drug products intended for human consumption.

III. In studying the accuracy of methods of analysis so that disputes may be adjusted without litigation and so that commodities be bought and sold by competitive bids and the prices made according to the composition of the commodities.

The association has just published its "Methods of Analysis," a book of 417 pages, with a preface by Dr. Carl L. Alsberg, Chief, Bureau of Chemistry, U. S. Dept. of Agriculture, president, Association of Dairy, Food and Drug Officials and secretary of the association. The book also contains an introduction by Dr. Harvey W. Wiley, honorary president of the association.

Dr. Wiley, I believe, has the distinction of being the only man who has attended all the meetings of the association. He was president in 1886 and secretary from 1889 until he retired from the United States service. He was responsible to a large measure for the growth of the association. May he long continue as its Honorary President.

The Carborundum Co., Niagara Falls, N. Y., announces the operation of its new plant at Perth Amboy, N. J., for the manufacture of refractories for high temperature furnace work and for furnace construction.

Oil Extraction by Electrolysis

A Description of the Rogers-Bennett Process

IN the article entitled "The Production of Edible Oils," in *CHEMICAL AGE* for September, 1920, the three known methods of extraction of oils were enumerated as follows: "Disintegration of the mass involving a disruption of the oil-sacs by (a) suitable solvent, (b) by rendering with heat with or without water, or (c) by pressure, mechanical, applied when the mass is cold or hot.

Methods (b) and (c) are the heritage of the ages; method (a) the contribution of the nineteenth century. It has remained for the year 1920 to mark the discovery and development of a fourth method, viz., the extraction of oils by electrolysis. In other words, a method has been found whereby the electric current is used for this purpose, thereby differentiating the process from anything in the art heretofore known.

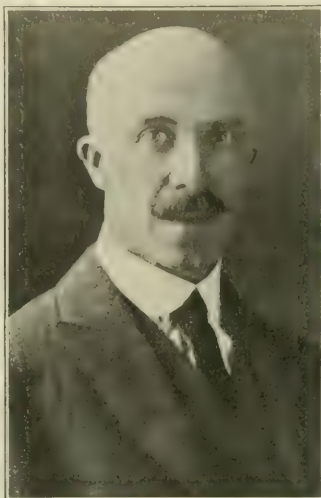
To George D. Rogers, Gloucester, Mass., graduate chemist, Massachusetts Institute of Technology, must go the credit for this discovery. Mr. Rogers, after his graduation, became connected with the fish industry in Gloucester, and in the course of his professional work had to do with fish livers and liver oils. Methods of extracting oil from this raw material appeared to him to be crude, and he set about in his laboratory to discover some means to extract a higher percentage of oil than was being obtained, as well as to improve the quality of the oil recovered.

This was the beginning. Let us examine the process (1) as to the mechanical equipment, (2) as to the theory and (3) as to the commercial application to fat-bearing materials.

Mechanical Construction

The mechanical equipment consists of a series of "coils" or iron pipes, say of 2 inches in diameter, through each of which passes axially a carbon rod 1 inch in diameter, thus leaving an annular space between the inside of the pipe and the rod of $\frac{1}{2}$ inch. The carbon rod rests in insulators outside, so that it becomes the negative electrode, and the iron pipe becomes the positive electrode, as shown in Figure 1.

To one end of each pipe is screwed a specially designed right angle end fitting, which is connected to a similar fitting on the next pipe by insulating hose, thus permitting the material to pass from one coil to the next. These



GEORGE DENNISON ROGERS.
Inventor of Rogers-Bennett Process of
Oil Extraction by Electrolysis.

coils, to the number of from 12 to 20, are connected in series, so that any particle of material is subjected to as many independent applications of current as there are coils.

It has been found that where the major part of these coils are surrounded by a heat bath, such as exhaust steam or flue gases, that the fatty materials in transit through the coils flow more readily, thus reducing the work on the pump which drives them through. Heat, however, is not necessary to the successful operation of the machine, but is advantageous.

Procedure

The raw material to be treated is first disintegrated, comminuted or ground, depending on the nature of the substance. Whole fish, beef fat, lard fats, etc., pass through an Enterprise chopper or similar device; while copra, cottonseed, etc., are flaked or ground. The purpose is (1) to permit easy mixing with the electrolyte, (2) to facilitate pumping to the electrolytic unit, and (3) to increase the effective action of the electric current applied to the system.

The material thus comminuted drops into a feed tank, into which is introduced in liquid or solid form such electrolyte as is best adapted to the fatty substance under treatment. Warm water also is introduced into the feed tank, thus causing the entire mass to become sufficiently liquid to pump readily.

From this feed tank the material is pumped usually by means of a gear pump into the base of the electrolytic unit and through the annular space between the carbon and pipe; the material thus passes through the entire number of coils, in each of which it is subjected to the electric current and emerges at the discharge and in the form of a suspension or emulsion.

It is very important to note that different electrolytes have remarkably different effects on the resultant products to such an extent that both color and odor of oils may be affected at will. De-colorizing and de-odorizing oils by this process is indicated as a commercial possibility as a result of experiments at this writing.

The remainder of the process is purely mechanical

and consists of (a) separation of solids from the emulsion, washing these solids to remove the surface oil, and dehydrating or drying the washed solids, and (b) separating the oil from the electrolyte in the suspension or emulsion.

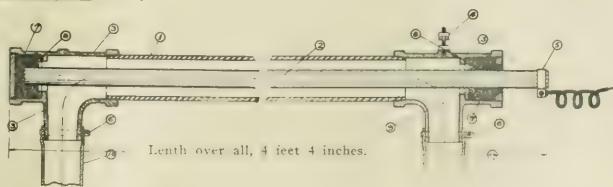


FIG. 1. CROSS SECTION OF ELECTROLYTIC CELL.

1, Tube; 2, Electrode; 3, Tube fittings; 4, Binding parts; 5, Ground clamps; 6, Hose clamps; 7, Porcelain insulators; 8, Leather packing; 9, U-packing; 10, Hose.

The class and quantity of material treated will determine the means of separation under (a). The material as it discharges from the electrolytic unit may pass through a rotating washing screen or may discharge to a basket-type centrifuge. In either case, the liquid discharged is, of course, carried over to a centrif-

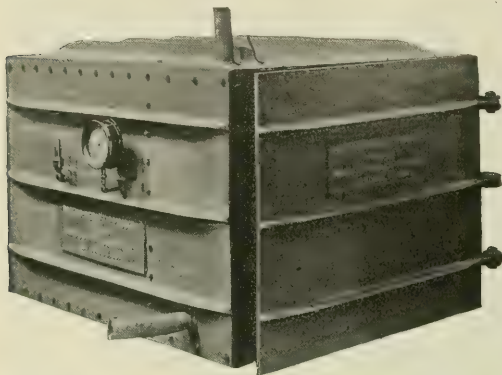


Fig. 2. Exterior View of Rogers-Bennett Electrolytic Unit. Built throughout of cast iron; containing 20 electrodes; size approximately 5x5x5; weight about 6,000 pounds.

ugal separator and clarifier. The percentage of moisture in the solid matter is greatly reduced when the basket centrifuge is used; the discharge, therefore, is in suitable condition for drying. When the rotating washing screen is used, as on materials in which the solid matter is of small value, the oil and electrolyte drop through the screen into a weir tank and from this pass to the centrifugal separator and clarifier.

The final separation of the oil from the suspension or emulsion is effected by means of a centrifugal separator. This separator, operating at 6000 R. P. M., effects an extraction of the entire quantity of oil plus a small percentage of moisture and impurities. The oil discharged from this machine is, therefore, approximately 105 per cent. of the oil content of the emulsion, and passes into a second smaller centrifugal clarifier, which removes the 5 per cent. of moisture and impurities, discharging a clear, dry oil.

Direct current electricity of from 90 to 120 volts, with an amperage of 18-24, is used continuously while the material is in passage.

Theory

When the current is applied it is conducted and the circuit completed by its passage from the iron to the carbon through the fatty mass because of the electrolyte in which this mass is immersed.

The action of the current in its passage through the mass bursts the fat cells instantaneously, thus producing an emulsion or fine suspension of the released oil and the electrolyte.

The best explanation that can at present be made of the phenomenon is that the equilibrium which has existed between the fat cells and the surrounding electrolyte is destroyed by the current action, with a consequent setting up of osmotic pressure within the cells themselves, sufficient in effect to rupture or otherwise cause the discharge of their contents.

So completely and effectively does the current act that practically the entire fatty content of the material is released. Tests on cod livers show a recovery of

99.75 per cent. of the original fat content of the raw material.

Commercial Application

The commercial application of the process is almost without limit. Such materials as beef fats, waste fats, livers, blubber, seal fat, menhaden and herring, as well as other oil-bearing fish, hog fats for production of lard, and, in fact, almost any animal fat can be rendered instantaneously by this process; the electrolytic application in all cases is the same. The auxiliary apparatus is changed to meet the necessities of the different raw stock. The fat cell membrane of the examples mentioned is of a protein nature.

Vegetable oil-bearing material, such as copra, coconut, cotton seeds, soya beans, linseed, castor beans, etc., require practically the same electrolytic treatment as the animal and fish fat groups, except that these materials, being of cellulosic, instead of protein, structure, require different electrolytes and give better yields when subjected to somewhat higher temperatures.

It must therefore be apparent that the economic importance of this discovery is tremendous, provided, of

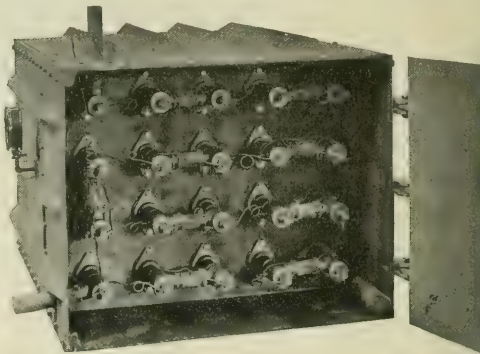


Fig. 3. Rogers-Bennett Electrolytic Unit with front door opened, exposing front ends of electrodes with wiring for series connection. Material enters through a pipe in lower left hand corner of the first electrode, passes to rear of the machine, crosses to the second electrode on the lower line and so on, finally discharging from pipe shown at the top.

course, that there are no important drawbacks or disadvantages factors. Therefore let us examine the application of the process to one or two materials concerning which definite results have been established.

Marine Oils

Fish livers, such as cod livers, produce two leading types of oil: (a) medicinal oil, a nearly white oil made from fresh livers 12 to 18 hours old; and (b) cod oil, a dark red oil made from livers of almost any age.

These oils at present are made by: (1) putrefaction or rotting of the livers; or (2) by cooking in a water-jacketed kettle for several hours at temperatures under 200° Fahr.

Rotting, or sun-trying, yields only a small percentage of the total oil-content and takes weeks to accomplish. The oil so obtained runs high in acid. The residue, containing a large amount of oil, either is thrown away or cooked and pressed to obtain more inferior oil of low value.

The water-jacket cooking requires several hours, gives off offensive odors and yields only a small percentage of No. 1 oil—the residue being pressed to yield a low grade oil.

Throughout the industry the general practice is to figure that 3 gallons of livers will produce 1 gallon of oil, or an average yield of 33 per cent.

As these raw livers contain frequently as much as 65 per cent. of oil the economic loss is tremendous.

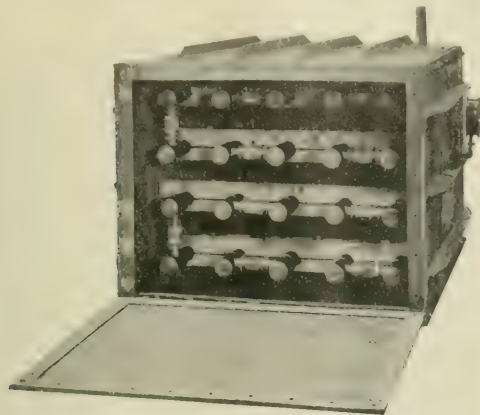


Fig. 4. Rogers-Bennett Electrolytic Unit with rear cover plate removed, showing rear ends of electrodes with insulated cross-overs. All parts of machine are readily accessible and easily removable.

Comparison with Electrolytic Process

Compare these results and methods with the results of the electrolytic process.

(1) The electrolytic process extracts practically 100 per cent. of the oil-content of the livers, fresh or old.

(2) This oil so extracted is all of one grade and quality and this quality is superior to the best grade obtainable by any known process.

(3) The entire process is odorless from start to finish.

(4) It is continuous and automatic. The livers are fed raw into one end of the process and in three minutes the finished oil is running into tierces or tanks in a steady stream.

(5) The residue or chum is automatically thrown out and may be dried for fertilizer or meal.

(6) The cost to produce 400 lbs. of finished oil is about six cents.

(7) The floor space is very small and the capacity, because of the continuous operation, only limited by the speed of the pump and the annular space between the electrodes.

Beef Fats

These fats are the basis of commercial oleo oil and oleo stearine as produced in packing houses. Tests made on such stock have shown yields of from 86 to 90 per cent. of the finest grade oil. These percentages are based on the weight of the material at the machine, and represent about 97-99 per cent. of the total oil content and are from 8 to 10 per cent. higher than can be obtained by the present methods.

Copra

Tests on copra have shown that the process will produce a coconut oil comparable to "cochin," the finest grade.

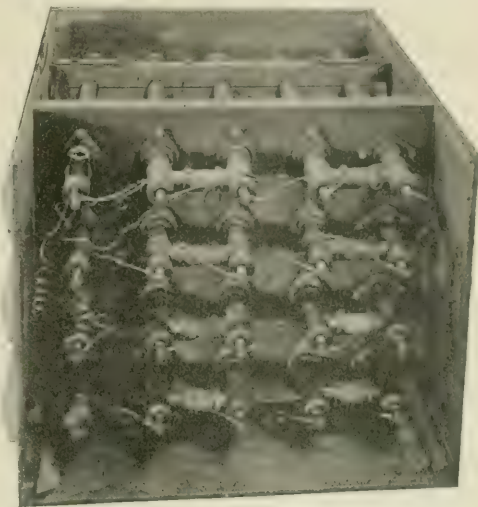


Fig. 5. Rogers-Bennett Electrolytic Unit with front door and top plate removed to show partition wall or header and steam-tight container in rear making temperature control possible. Flue gasses, or exhaust or live steam can be introduced into this chamber to keep the mass warm while in transit through the coils.

Power Requirements

A complete unit suitable for the production of fifty 400-lb. barrels of oil per day of ten hours operating on livers would comprise the following equipment.

1. Feed Tank.
2. Pump.
3. 3 H. P. motor to operate pump.
4. Electrolytic unit.

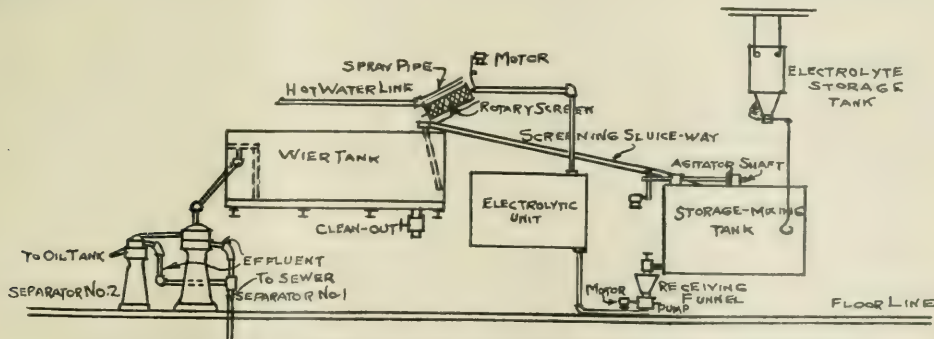


FIG. 6. DIAGRAM OF INSTALLATION OF ROGERS-BENNETT ELECTROLYTIC PROCESS.

- | | |
|--|------------------------------------|
| 5. 3½ K. W. generator set to supply necessary current. | 8. Centrifugal separator |
| 6. Rotating screen. | 9. 2 H. P. motor to drive same. |
| 7. Weir tank. | 10. Centrifugal clarifier. |
| | 11. 1 H. P. motor to operate same. |

It will thus be seen from the foregoing that outside of the 3½ K. W. generator about 6 H. P. is required for the operation of the complete plant.

Floor Space

The floor space required is comparatively small, to wit, the electrolytic unit will take a space of about 5x5x5, the weir tank about 6x4x4, the centrifuges approximately 2x2½ each and the small additional space

required for the motors and generator set. It is not necessary to have the entire equipment on one floor as the centrifugals may be located in the oil house while the unit may be close to the incoming supply of raw material.

Development

The design of the mechanical equipment and development of the process in its application to all industries is in the hands of Robert P. Bennett, of Orange, N. J., a graduate of Cornell University, hence the process is commercially known as the Rogers-Bennett Process. Mr. Bennett was the first to realize the many applications of the process and to foresee its economic possibilities.

Chlorine Consumption and the Dispersion of Alkali Manufacture

A STUDY of the statistics of American soda ash production for the twenty-year period of 1899-1919 prompted the inquiry in the August CHEMICAL AGE: Have we passed the peak of soda ash production?

The increasing demand for liquid chlorine is viewed with satisfaction by those who are interested in or employ the electrolytic cell for caustic soda production, for expansion in the use of this convenient device is determined primarily by the development of greater consumption outlets for chlorine. The use of chlorine in chemical synthesis is negligible and probably always will be inconsiderable in comparison with its use as a possible general bleaching agent, whereby it displaces bleaching powder wherein the lime compound serves merely as a vehicle for the essential ingredient, chlorine. As a germicide in water purification, its place in waterworks practice is established.

The superior stability, uniformity, dependability, convenience, economy and efficiency of a pure material over a vehicle, which, after its passenger is discharged, remains to vex the operator, to say nothing of the many disagreeable features incident to handling the vehicle, makes only a question of time the general displacement in large-scale industrial bleaching of the by-product of a historic chemical industry.

The direct influence of such a condition only can be to disperse alkali manufacture in that department which furnishes caustic soda as the product of the causticization of soda ash.

Vendors of electrolytic cells, of which there are several of established merit, thus insuring the healthy market condition inherent in competition, view with equanimity the economic results of their ingenuity and enterprise.

The necessity of effective and dependable chlorine-control devices in the use of an active and virulent gas handled under pressure in liquid form is apparent. The merchandising of this mechanical equipment is closely controlled, with resulting pecuniary advantage, which industry should not begrudge in consideration of the service rendered. This situation is interesting in that an essential chemical element must pay toll to a mechanical device for its opportunity to work.

Building for National Research Council

A site in Washington, occupying an entire block and facing the Lincoln Memorial in Potomac Park, recently has been obtained for the new building which is to serve as a home for the National Academy of Sciences and the National Research Council.

The academy and council have been enabled to se-

cure the site, costing about \$200,000, through the generosity of the following friends and supporters: Thomas D. Jones, Harold F. McCormick, Julius Rosenwald and Charles H. Swift, Chicago; Charles F. Brush, George W. Crile, John L. Severance and Ambrose Swasey, Cleveland; Edward Dean Adams, Mrs. E. H. Harriman and the Commonwealth Fund, New York; George Eastman and Adolph Lomb, Rochester; E. A. Deeds and Charles F. Kettering, Dayton; Henry Ford, Detroit; Arthur H. Fleming, Pasadena; A. W. Mellon, Pittsburgh; Pierre S. duPont, Wilmington; Raphael Pumpelly, Newport; Mr. and Mrs. H. E. Huntington, Los Angeles; Corning Glass Works, Corning, N. Y. Funds for the erection of the building have been provided by the Carnegie Corporation of New York.

The National Research Council has established a Research Information Service as a general clearing-house and information bureau for scientific and industrial research. This "service" on request supplies information concerning research problems, progress, laboratories, equipment, methods, publications, personnel, funds, etc.

Ordinarily inquiries are answered without charge. When this is impossible because of unusual difficulty in securing information, the inquirer is notified and supplied with an estimate of cost. Request for information should be addressed, Research Information Service, National Research Council, 1701 Massachusetts Avenue, Washington, D. C.

The Du Pont-Hercules Plastics Patent Litigation

In the action in the U. S. District Court for the district of New Jersey of E. I. Du Pont de Nemours & Co. against the Hercules Powder Co. for the alleged infringement of the Kniffen (Nos. 1,118,498, 1,135,026) and Hitt (Nos. 1,321,633, 1,321,634) patents for alleged improvements in process and in solvent for forming pyroxylin bodies, the defendant's answer in controversion of the patentability of the subjects of these alleged patents, avers that the claims therein are void.

The defendant's answer is a valuable document to the technologist in the plastics industry, inasmuch as in support of its position that the plaintiff's alleged inventions, improvements and claims are not new, novel and original, it appends a compilation of U. S. letters patent, and British, French and German patents, and publications on the subject, that constitute a technical chronology of the art.

A valuable contribution to the history of the art in America appears in a list of over 75 names of individuals and corporations that for two years prior to the date of the patents in question, dealt in or used the subject matter of the patents,

Cooperation of the Colleges and Industry in the Development of Managerial Ability

By Dr. Hollis Godfrey

President, Drexel Institute; Chairman, Council of Management Education; Former Commissioner of Engineering Education of the Advisory Council of the Council of National Defense.

IF there is any branch of industry which should welcome a union between industry and the colleges it is the chemical industry.

The enormous advance made in industry during the past 100 years has been due largely to the chemist and those who have devoted their lives to perfecting chemical products. Indeed, only a few years have elapsed since the chemist became an important factor in industry, that is, a recognized factor. "I remember," said a steel man to me last week, "the time when we sold something hard and called it steel. The customers alone demanded that hard material. Today all is different; the chemist has taught us and the trade."

Ask the empirical business man what part science plays in his business and, at first, he will answer "none." Make him sit down and analyze his business and you will make him admit that science is the controlling factor. Carry him farther and, unless he is hopeless, you can make him admit that education is the super-controlling factor, for industry is composed of men, money and materials, and money and materials are dead and inert until acted upon by man, and man alone is acted upon by educational forces. The majority of the big business men of America today are recognizing the fact that education is the great power behind their business. They have stopped looking at the chemist, the biologist and the economist as "experts." But they have not looked on the colleges, the industry of education, as the place from which they must obtain their future executives. They have been willing to pay big prices for "expert" advice, but have been disinclined to train that expert in their plants from the start.

The executives in industry have had it in their heads that the office boy who arose from the task of filing letters or cleaning the place was more valuable to his business than the young college graduate. In the majority of instances the office boy was a more valuable asset. That was the fault of the employer and the college.

Between the educational institutions of the country and industry there has been a yawning chasm. The colleges have been turning out students in a machine-like manner and sending them into the world without qualifications for every-day life. When the graduate entered an office he was literally lost—he knew nothing of human nature, had no business experience and his whole

mental machinery was in a grove. It usually took four or five years before that college man was of value to his employer. After that time the employer, however, realized that the man with a college training outstripped the office-boy graduate more than two to one. Why? Because he had a trained mind as a foundation.

Today the big industries in this country and England recognize that trained mind. They know that it is essential that their executives should be men of the college type. Education has been victorious.

A new day has dawned. Today the colleges and industry have a common meeting ground and are tackling

the common problems of the two in a masterful manner. The mistakes of the past are being remedied. This common meeting place or clearing house for all industrial and educational matters is the Council of Management Education of which I have the honor of being chairman.

The Council is an outgrowth of the war. That great group of educators who served the government during the war recognized the need of imparting the knowledge gained during the struggle to the country in times of peace. Exactly how to do this was a question. It was first necessary to determine exactly how the work could be continued and exactly what industry needed. Under the auspices of the Technology Clubs Associated of the Massachusetts Institute of Technology a survey was made of industry in the eastern part of the country. The result of this survey, from New England to Texas and from the Atlantic to the Mississippi, showed that 250 of the greatest executives agreed that there were four great needs, viz., decreased cost, increased production, increased stability and increased incentive. They also agreed that these needs alone could be met by education. A convention was held in the Drexel Institute, Philadelphia, last March, when presidents and deans of the leading colleges met with about 200 executives of industry. The result of that convention was the establishment of the Council of Management Education.

Today the Council is functioning. It is backed by industry having a combined capitalization of more than \$26,000,000,000. The American Council on Education, representing the 620 colleges of the country, is working in close cooperation and has appointed a very strong committee to work permanently with the Council.

What is to be accomplished? The Council is dedicated to the task of bringing the colleges and industry to-



HOLLIS GODFREY, Sc.D., Eng.D., LL.D., F.R.G.S.
President, Drexel Institute, Philadelphia.

gether. It proposes to help industry obtain a supply of properly trained men. It will do this by working in the colleges and industry, to bring about a meeting of minds and in rendering every possible assistance to undergraduates. It will be the clearing house for all matters affecting colleges and industry and the point of dissemination of information of help to all. The Council proposes nothing radical, nothing to deprecate the regular arts courses in the colleges and nothing to upset traditional educational beliefs. It does, however, aim to change certain set rules in order that students and industry may be helped. It proposes to give the colleges specifications from the various industries and thus enable the college to prepare courses to make fit the students to enter the industry of their choice. Moreover, the Council will place thousands of students in industry during the summer months. This will enable the undergraduate to determine whether he has made a wise choice, help him pay his expenses in college and enable the executives in industry to see whether the man is adapted to the line.

One of the greatest functions of the Council will be the introduction of courses in Management Education in extension work. This will reach the men in industry who have been deprived of a college training, viz., superintendents, foremen, all who work with their brains. Courses have been prepared by a committee of eminent educators. So many colleges have asked for the courses that not one-tenth can obtain them for a year or more as the Council sends experts to study the field before definite courses are proposed.

The Council is financed alone by industry. Associations or individual firms may join and all are welcome. To date seven of the great industries are included and research is progressing in their fields.

The executive members of the Council appointed to represent their industrial group are as follows:

Railroads. A. W. Gibbs, chief mechanical engineer, Pennsylvania Railroad.

Paper. Colonel B. A. Franklin, vice-president Strathmore Paper Co.

Public Utilities. H. B. Shaw, educational director, H. L. Doherty Co.

Shoes and Leather. Frederick B. Rice, president, Rice & Hutchins.

Mining. J. Park Channing, mining engineer.

Machinery and Metals. Frederick H. Payne, Greenfield Tap and Die Co.

Rubber. Dr. R. S. Quinby, service manager, Hood Rubber Co.

Cotton Finishing. J. K. Milliken, president, Mt. Hope Finishing Co.

Textiles. Albert Bigelow, Ludlow Manufacturing Co.

The educational group includes, besides Doctor Capen, of the U. S. Bureau of Education, and myself, Dr. Frank Graves, dean of the school of education, University of Pennsylvania; Dr. Charles Tilden, professor of engineering mechanics, Yale University; Dr. David Tennant, professor of biology, Bryn Mawr College; Dr. Leigh Reid, professor of mathematics, Haverford College; C. L. Evanson, professor of engineering administration, Drexel Institute, and J. S. Pearson, professor of production engineering, Drexel Institute.

The American Council on Education has appointed the following committee as a permanent body to cooperate with the council of management education:

Doctor Capen, chairman; Dr. Charles R. Mann, chairman of the advisory board educational training of the general staff, War Department; Frederick L. Bishop, dean engineering school, University of Pittsburgh; Park R. Kilbe, president Municipal University of Akron; Raymond Hughes, president Miami University.

The Back-Wash of Thrift in Chemical Manufacture

In the labor scarcity of the production activity of war time the demand for every device that would liberate labor for martial use was unprecedented. The prime consideration was output for purposes of destruction. Notwithstanding waste and extravagance incident to urgency, the most efficient utilization of the human factor was the main problem of the production manager.

Now with the consumer in revolt at price levels resulting from these exceptional conditions, the restrained consumption inculcated by the preaching of thrift has induced a current of deflation now in swelling force throughout the world. Production slackens because of the inhibition of reduced consumption which can be revived only on a lower level of prices. Self-denial has backed up a demand which when released will inaugurate an era of prosperity comparable with that of war-time production but devoted to the creation of wealth and not to its destruction.

The lower price level will not become general until every element that enters into production costs undergoes its proportionate deflation represented by an honest return of effort for the highest wage that a reduced selling price may warrant. Inasmuch as labor constitutes 85 per cent. of the cost of manufactured goods, either of two conditions must obtain, viz., the present wage remaining permanent must be matched by an enhanced productivity whose output at once can carry the war-time wage and permit a price that will encourage correspondingly increased consumption, or labor must submit to the inexorable demands of economic law, which its leaders believe can be flouted to its advantage, and forego a portion of its profiteering profits, that mankind may have the goods it needs at prices it can afford to pay.

Under either condition the installation of labor-saving and cost-reducing facilities in all branches of manufacture, wherever volume of output, standardization of processes and the conditions peculiar to the special industry warrant, becomes a compelling necessity.

Lagging trade in cotton, silk and woolen goods manufacture, in the leather and rubber industries and in many lines using chemicals in direct touch in the distributive process with the consumer finds its reflection in chemical manufacture in reduced activity which will persist until accumulated stocks are worked off in the resistance of a falling market.

Inactive producing capacity is a poor environment for the introduction of manufacturing economies which can have their maximum effectiveness in reducing costs only in full capacity operation. Industry awaits the stabilization inherent in the conviction that price adjustment has run its course for on no other basis can renewed demand be expected.

In 1919, in the 108 American plants engaged in the preservative treatment of wood, there were consumed 65,556,247 gallons of creosote, 2,412,592 gallons of paving oil, 102,011 gallons of miscellaneous preservatives, in addition to 43,483,000 pounds of zinc chloride, the largest quantity of this preservative ever reported by the industry. Of the creosote 6,493,000 gallons were imported chiefly from England and Canada. The total amount of wood subjected to preservative treatment by the 108 plants that were active during 1919 was 139,878,584 cubic feet, or 17,265,694, more than the previous year. About 80 per cent. of this wood consisted of railroad crossties.

Relationship of Cost Accounting to Business Management in Chemical Manufacture

By William B. Ferguson

President, Philadelphia Engineering & Sales Corporation

THE investigators of the staff of the United States Tariff Commission doubtless surpass all others, who are interested in the general subject and appreciate its importance, in intimate knowledge of the situation in the chemical industries as regards accurate methods of ascertaining and recording production costs.

As the basic idea of the protective tariff is one that will equalize production costs in the manufacture of

Jersey Zinc Co., has so clearly pointed out in an industry that only cooperation has saved from demoralization, viz., that zinc men of the United States can compete permanently in the world's zinc markets only by reducing costs, applies as well to every branch of chemical and allied manufacture.

Objects of Cost Keeping

Cost keeping is simply a means to an end. It does

not in itself increase the efficiency of a business, but it is a most powerful aid to management in improving the efficiency. The principle objects aimed at by management to which cost-keeping contributes so greatly, may be briefly stated as follows:

- (1) To reduce the costs; by showing comparisons between actual and standard costs for all activities and sections of a business.
- (2) To increase production indirectly, by a similar process. A cost system without production records is incomplete.
- (3) To introduce machines to do work hitherto done by hand.
- (4) To balance up the production between departments and keep an even and regular flow of materials throughout.
- (5) To serve as a guide to selling and to pricing.
- (6) To afford a basis for comparing the ability and efficiency of superintendents, foremen and workmen.
- (7) To substitute accurate and fair records of performance and economy for personal opinions of partisan supervisors.
- (8) To create healthy competition between departments, and insure a fair distribution of reward to all individuals on their individual merits; thus making for "the square deal."

None of these objects in management can be accomplished completely and safely without the help of a good cost system; a better name would be a Cost-and-Production Control System. The success of the manager depends upon his degree of control of production and costs. My experience has been that the control lever in increasing production and reducing costs, the

proper exercise of which invariably increases the interest needed to make improvements, is a form of advertising the results, *i. e.*, cost publicity in the factory or plant.

Comparisons of all departments need not necessarily be made in dollars, but the relative efficiencies of departments can be worked out weekly and distributed to all superintendents and foremen, each one seeing how the others compare with himself. This phase of management usually comes under the manager himself or someone who is "production engineer," in fact if not in

When manufacturers, only a few years ago, first began to figure on odd scraps of paper the value of material and labor that went into a job, they did it as a guide to setting the selling price. Even today that is about all the use that is made of cost figures; but the more advanced are realizing that figures can be used as a guide in determining selling and manufacturing policies, and to check up the efficiency of departments, foremen, workmen, materials and machines.

The efficiency of workmen is shown up too by the more modern cost systems which give, weekly or monthly, the labor cost per unit of output in comparison with those of other periods. Often an investigation of high overhead for a department, initiated by a monthly cost report, will show the need of better production planning in that of a preceding department.

Practically, there is no bad condition which can exist in a plant that is not shown up by a cost system of the more modern kind. Sometimes the cause can be determined directly from the cost reports. More often the reports merely show up the symptoms and the trouble must be localized by investigation.

Another interesting use is being made of cost accounting by groups of business men, who realize that the really dangerous competitors are the men who do not know their costs. . . . This has led to the rise in several industries of so-called uniform costing systems.

Cost accounting is a rapidly advancing science, which is being accepted by manufacturers as an invaluable tool of business. —W. R. Bassett, of Miller, Franklin, Bassett & Co., New York.

In the various reported studies of the Commission, frequent reference is made to difficulties encountered in procuring reliable information as to production costs arising from the extremes of absence of cost records to such diversity of methods as to preclude any uniformity and hence reliability of results from their comparative study.

The chemical industry is peculiar in the difficulty of the standardization of manufacturing methods beyond the operation of particular processes. This condition is due not only to the multiplicity of the processes themselves, but to the varying degree of efficiency with which any particular process is conducted.

In our industrial development the time rapidly is passing, if it not already has passed, when manufacturing inefficiency can seek refuge in the paternalism of government for protection from its own industrial folly, in this era of the integrated economic interests of the world. This world is big enough for everybody in it. The doctrine that one can not live unto himself alone, is of national and international application, one of whose chief tenets is that if we are to sell goods and are to take our place in the merchandising responsibilities of the world, we must play as well the role of a buyer in international markets.

We cannot escape the conclusions that freedom of trade is the logical outcome of manufacturing efficiency, and that the contrary doctrine is the equally logical expression of contrary conditions, where comparative living standards are not involved.

No gathering of manufacturers is without its due emphasis on the importance of cost studies as a means of reducing production costs.

What George C. Stone, chief metallurgist of the New

name, but the data is all furnished by the time cards and material records.

The judicious display by departments of the "Cost Efficiencies" involves very little extra expense, yet its results often are remarkable. Working up from detail operations and functions, a standard cost for any given production can be set for each department, not only in the so-called "productive" departments, but also in all the "service" departments as well; variously known as the non-productive or overhead departments, including not only the plant, maintenance department, etc., but also the executive and clerical forces. This is really the "Budget System" of allotting funds and controlling expenditures.

Costs by Organization Units

In order for costs to be collected by departments and sections of a business or factory, and to be distributed to supervisors in the same way, thus measuring the relative efficiencies of departments and individuals, it is of course necessary first of all for the classification of accounts to be based upon the organization of the factory. An organization chart is usually necessary, showing the functions and operations coming under each department.

Before the cost accountant can devise a good cost accounting system, the manager has to perform his prime function, that of organizing properly. It is always possible to make an organization chart of a business which is organized properly; then to assign numbers or letters to all the divisions, departments and sections of the organization, preferably using the Dewey Decimal System. Then the accountant steps in and bases his cost system classifications upon the organization numbers, and collects costs by organization units, which enables the manager to hold some one person responsible for each and every cost-group. This localization of responsibility for costs is the keystone of cost and production control, and is the first essential of the cost system of modern management.

Final costs by articles are of course desired, but as far as cost-control and cost-reduction are concerned, final costs are nothing like so important or useful as group costs, *i. e.*, responsibility costs.

The Complete Accounting

The complete cost accounting and financial accounting structure can then be built upon the cost control foundation as discussed; combining or classifying further as may be required for financial statements or reports. There are so many varieties of business and

industries that it would be folly to discuss here any general procedure, but it may be said that before either a good cost system or accounting system can be devised to fit a particular plant, a most thorough study must first be made of the organization and processes of that plant. A knowledge of other similar plants is valuable in such a study. A plant in need of a good cost accounting system can not get one ready-made off the shelf.

It goes without saying that when a cost-control system is designed to fit a particular organization, and there are changes in the organization of a nature to change the cost groups or their components, then the corresponding changes must be made in the cost collecting and classifying. This would be true for such changes as transfer of functions and personnel from one department to another, moving machines or operations from one department to another, adding new functions or products to a department, and so forth.

Cost keeping for each industry and plant is different. In manufacturing, the system for a "continuous" or tonnage type of production is quite different from one for the "assembling" type. In the latter type, there are again several varieties. In repetition manufacturing detail costs by operations are required, but in a jobbing plant, this might be unnecessary for each article turned out. Shipbuilding is a particularly complicated manufacturing industry requiring cost comparisons in various forms for the best results.

Overhead or Indirect Costs

The manager usually needs the most assistance from the cost records in properly interpreting the relation between overhead costs and efficient management.

The interpretation of overhead costs in reports of factory or departmental efficiency may be very erroneous if great care is not exercised; and here again true comparisons must be made before true conclusions can be drawn. The modern manager should be familiar enough with accounting to know the various methods in use for distributing overhead to departments. He should understand why the percentage-on-direct labor method is used in some plants, why the machine-hour

rate is used in another, and why the production factor system is used in another. He should know that any method whatever is arbitrary and only approximate and that therefore "accuracy" in costs is a relative term.

The reports should show what portion of departmental overhead the department itself is responsible for. The same management principle should be applied to distributing overhead as mentioned above. No one should by the cost reports be shown responsible for

The industry that is being operated without proper and correct cost figures will never reach a safe harbor, but instead will be wrecked in some unsuspected moment through some unknown cause. No competent executive will today speak disparagingly of the cost engineer—the man who gives to the manager a record of costs while it is yet time to remedy conditions that may cause serious loss. It is as dangerous to operate a plant without the right sort of cost system, as it is to operate a ship without a pilot. The ship without a pilot is likely to be wrecked at any moment, upon unseen shoals.

Is it not ignorance of the actual elements of cost and of their respective significance that accounts for a large share of labor trouble, of unfair competition, of failure, of profiteering? It is our conviction that it is. The employer, not knowing the correct relationship between the cost of labor, of material and of management, concludes, when profits decrease, that he has been paying too much. A reduction in wages takes place—a labor fight ensues.

A manufacturer, ignorant of actual costs, or through a faulty system, arrives at an erroneous cost of a unit of production, or of a piece of construction. One of two things happens; either his price or his bid is too high; consequently he does not sell or obtain the contract. This repeated a few times and a bankrupt business results. Either this, or he bids too low. He sells his product or obtains the contract. He loses money, eventually the same result as before—bankruptcy.

In either instance the man who knows his costs suffers, and it is only a question as to which has the more capital as to which one will fail first. But it is unfair and dangerous competition.—L. W. Wallace, President the Society of Industrial Engineers.

cost figures for which he is not responsible, or only partly responsible. This is frequently a difficult thing to do in practice, but yet for cost control, localized responsibility is a very essential thing. If it cannot be done, then it is better from a cost-control standpoint not to distribute the overhead in the cost reports that go to department heads, but simply to include them in factory costs later on. Here again is required a close study of the whole organization and of responsibility for this or that group.

At this point I cannot refrain from emphasizing one particular phase of this subject of overhead, from the viewpoint of the production engineer, industrial engineer or manager. That is, the separation of departmental overhead, or in fact all overhead, into two distinct parts, one of which is really incident to production, and the other incident to non-production or idle time of equipment.

The purpose of making the distinction between the "productive overhead" and the "non-productive overhead," if one might use such unorthodox terms, is to keep separate the efficiency of factory operation management from the efficiency of sales management, or separate from general business conditions.

In other words, the factory cost figures needed for cost control by the factory manager and his superintendents are "efficiency costs" for which they and they alone are responsible. One method of handling this problem is to determine periodically what is normal overhead for normal output by whatever units are desired, departments, operations, or articles; and when lack of orders causes the factory to run below normal capacity, only distribute the pro-rata share of overhead expenditures to the product. The difference is "loss" due not to inefficient operations, but to idle capacity.

Graphic Methods of Control

Presentation to the manager of cost data in complete

and convincing form is necessary for cost control. He must be able to understand their meaning and significance, must have faith in their accuracy and fairness, before he is likely to act upon them to the extent of investigating and remedying the conditions revealed. To be persuasive, cost reports should be readily digested and impressive in their significance. Frequently they can be translated into language that the average executive can appreciate; but more frequently they are more readily grasped if they are graphically displayed in chart form, thereby bringing out comparisons with standards, past performances, other plants, other operations or data of interest.

The work of the cost accountant and that of the industrial engineer in obtaining proper records and interpreting them aright are closely related and interdependent.

Production engineering and accounting go hand in hand, and each is dependent on the co-operation of the manager himself and the operating forces, even down to workmen whose time tickets are the original records of labor costs.

The alert manager realizes that the modern industrial accounting system is the rudder to his ship, by which he steers in the right direction in his betterment program. Without this, he must simply "drift" into improvements, and when a gross inefficiency meets his eye, goes after it. The cost system may again be compared to the X-Ray of the physician; it searches out and discloses the conditions in the factory system, such as would remain hidden and uncorrected, only to show up later in the dreadful malady of excessive total costs.

Just as it would be of advantage to every business man or manager to know as much as practicable for him to learn about cost accountancy and cost control methods, it would likewise be of advantage to the cost accountant to know as much practicable about the business itself, its organization, functions, activities and operations.

Hampered Production Maintains High Cement Prices

By John A. Morron

President, Atlas Portland Cement Co.

I DO not expect any overproduction of Portland cement in 1921. The possibility of a price reduction depends on the supply of coal and labor.

Labor scarcity is the chief difficulty confronting manufacturers. Cars are reported to be available in sufficient number and adequate coal is obtainable, though deliveries under contracts frequently are not being made, and open market prices are much higher.

Because of these conditions some mills are operated way below capacity and have been for a year. The country's production this year is falling short of requirements by a considerable margin.

Production of cement this year is estimated at 95,000,000 barrels. In recent years production was as follows:

	Barrels		Barrels
1919.....	85,485,000	1915.....	85,914,907
1918.....	70,915,508	1914.....	88,230,170
1917.....	90,630,000	1913.....	92,097,131
1916.....	94,552,296		

Demand this year is unequalled in the industry's history, but owing to shortage of cars the mills have been unable to bring in their limestone and other raw materials in adequate quantities. As a result, although production in September was 10 per cent. greater than in the same month last year, and 45 per cent. over 1918, the supply of cement ready at the mills is half what it was last year and 40 per cent. of 1918 stocks.

Consequently at present prices demand is keeping up well. There is no tendency of buyers to cancel as might be expected if a price decline were foreseen. Present base prices are \$2.50 a barrel, Lehigh Valley, and \$2.60, Hudson River mills, against \$1.75 when Government regulation ended, and \$2 in March. Adding \$1 for sacking (refunded), 30 cents freight from Hudson, N. Y., or 58 cents from the Valley, companies generally are selling dealers at \$3.90 a barrel, New York. Some manufacturers, however, have recently fixed prices at \$4.09, or, in one case, as high as \$4.59, and find they can do business at the higher prices. Retail sales are between \$4.75 and \$6.45.

Victor Chemical Works, Chicago, Ill., has started operation of its new plant at Nashville, Ten., devoted to the manufacture of phosphates. This plant embodies the most recent developments in chemical construction and represents an investment of over \$1,000,000.

* * *

The Empire Potassium Phosphate Co., capital \$500,000, has been incorporated by G. L. Vincent and A. F. Dodd, Emporia, Va.; R. F. Graves, Raleigh, N. C., and A. L. Kreiss, Meriman, Neb., to exploit the process of Mr. Kreiss, who is a chemical engineer, to utilize North Carolina feldspar and Tennessee phosphate rock to make a potassium phosphate fertilizer.

An American Chemist in Relief Work in Germany

By James G. Vail

Chemical Director, Philadelphia Quartz Company

THE industrial chemist often is called upon to undertake tasks far removed from the chemical laboratory. We recognize that he may do his purely chemical work better for a wider point of view. I have just returned from an experience which, while it involved very little chemical work, may be of interest to chemists as citizens and may suggest to employers that chemists often are willing to tackle other problems than those that can be solved with test tubes.

Speaking for my colleagues in the chemical profession, I feel that great potentialities of usefulness lie untouched in the domain of aspiration and activity encompassed by the intensive preparation for service which we call chemical education. Truly, what a man can do depends upon his determination to do and upon his willingness to qualify himself for the ever greater opportunities that always lie just beyond. In the expansion of the chemist's horizon in his wider contact with men and affairs lie the stimuli to growth; and in his reaction to these stimuli will he display the measure of his usefulness as a man.

Dedication to Service and First Impressions

In December, 1919, I joined a group of volunteers, who went out under the auspices of the American Friends Service Committee to organize the feeding of under-nourished children in Germany. This committee had undertaken its task at the request of the American Relief Administrations, European Children's Fund, of which Herbert Hoover is chairman. We arrived in Berlin on January 2, 1920, and our first impression was a dreary one. The city, once immaculate, was dirty and run-down. Everywhere the need of paint was evident. There was little street traffic. What there was was mostly drawn by underfed horses driven by ill-clad drivers. There were bright spots in the hotels and cafes, where people with plenty of money could exchange it for wine and revelry. It did not take long to find out that this had little relation to the condition of the great majority of the people.

We set out to learn the condition of the children. Individual cases do not tell the story. You may find pitiful cases of under-feeding and sickness among the children of any great city of the world. The question was how many children were in the distressing condition of those we saw. A study of the statistics, with such verification as was possible, seemed the only fair basis of judgment. We found that tuberculosis had increased about 100 per cent. since 1914. In the city of Bremen, for instance, in 1914 there were 13 cases of tuberculosis of the lungs per thousand of the population and in 1918 there were 25. Other cities were worse; few were bet-



JAMES G. VAIL,
Chemical Director, Philadelphia Quartz Company.

ter. Scrofula and rickets also had increased tremendously. Everywhere one could see great numbers of pale, anaemic-looking children. In Hamburg the average weight of a girl of 13 years was slightly more than 20 pounds below the pre-war average. This figure is taken from a group of 10,000 weighings of children who received the American food. This is an extreme figure, but everywhere the statistics show the children to be undeveloped both physically and mentally.

Economic Conditions

There was, and still is, a great amount of unemployment in Germany. The crux of the situation is coal. In numerous workingmen's families which I visited there was no fuel available for heating and only enough to permit the cooking of one meal per day. In 1913 Germany used 85.7 million tons of coal for household, industrial and agricultural purposes. It appears that she cannot have above 47 million tons in 1920 if maximum production should be obtained. This does not allow enough industrial activity to permit the imports necessary to feed the people. Those industries which require a minimum of raw material

and a maximum of labor are the most active. The great Krupp works in Essen are making bicycles, typewriters, padlocks and other small machines where labor is the principal item. The optical works of Zeiss at Jena are of the same class. With aggravated labor troubles, partly due to the doctrines which come across the border from Russia, the average manufacturer is greatly discouraged and finds it very hard to conduct business.

Hunger is the Mother of Radicalism

Labor in Germany is very restless and becomes more so as the difficulty of securing food or employment becomes more acute. I witnessed on several occasions mob-protest against prices of food and against the inability to secure work. The nearest estimate that I can form is that one factory smoke stack in three is at work. Now Germany is an industrial country and has for many years been dependent on imported food-stuffs. Unless she can secure the materials to be more active industrially, she cannot buy sufficient food abroad, and without food no stability is to be hoped for.

The value of money has decreased and fluctuated until it is no longer possible to give an idea of values in terms of money alone. A skilled workman, steadily employed, may earn M.15,000 a year, on which with great care he can support a small family. Many a college professor, however, receives less than a third of this amount and great numbers of government workers and persons who are dependent on fixed incomes are in a very acute situation.

The Payors of the German Penalty

So the children, regardless of class or creed, were sought out by medical examination and the most needy were served in public places, mostly in the school rooms, with one cooked meal a day. This meal contained a little more than 650 calories and was prepared and served under a carefully worked out control, from both business and scientific viewpoints. I have been asked, "What will this one meal do?"—and the answer is that immediate improvement in attention at school work and more gradually gain in weight were noticed. In one city 5,000 children between the ages of 6 to 14 gained an average of 5 pounds each in eight weeks. They and all the teachers and officials with whom we had to deal were most appreciative, but though we fed 632,000 in this way, only half of the number who really needed sustenance could be accommodated. Meals of good quality and capable of producing the results indicated can be served for less than 5 cents each. The appeal is earnestly made to the idealism of America, which never made war on women and children, to come to the aid of these little ones who had no part in the great war which has brought calamity upon them. Without more and better food they cannot grow into healthy citizens.

The Dicer's Luck and the Compassion of the Victor

In the course of this work, we met everywhere the people who represent the best element of Germany. They gave unselfishly of such as they had to help the children, but they were not as efficient as they used to be.

A certain weariness and discouragement we met at every turn and in all classes of society. In the office mistakes were made; and as we dealt with business men we could not avoid the feeling that their grasp of problems was such as might be expected from tired and disheartened people. Under better conditions, I believe that they can recover.

I also believe that if these conditions are brought about by American idealism friendliness and mutual understanding will result. The hands that have cast aside the control of the Prussian militarist in this way can be supported and helped to build a better Germany which shall be a useful member in the great family of nations.

We earnestly are hoping that it will be possible through American generosity to feed 1,000,000 children a day through this winter and that in another year such work will not be needed.

The Function and Preparation of Starters in Oleomargarine Manufacture

By A. E. Hoffman

Troco Nut Butter Company, Chicago, Ill.

FOR many years I have been closely identified with the butter industry and some of my friends are amazed at my new work. My answer to them has been that I believe oleomargarine has a legitimate place in the channels of trade, and it is only fair that I do what I can to develop it.

Quality is the rule by which profits are measured. It costs no more to manufacture a good product by using care and judgment than it does to manufacture a poor one. It requires the same amount of labor and about the same amount of money for materials. When one takes into consideration the loss on goods returned because of lack of quality it costs more to make an inferior grade than a high one.

These fundamental principles are applicable not alone to a chemical and bacteriological industry but to every industry.

I would not detract in any way from the butter industry, but I am intensely interested in making oleomargarine so good that it will stand for all that the name *Quality* suggests. In order to reach and maintain this standard you must have at the head of your manufacturing department men who know their line. You cannot place a value on the man who can *do* things. The man who *cannot* is a poor investment at any price.

We all agree that the materials used in the manufacture of oleomargarine must be of good quality, the oil as well as the milk. Oil is very susceptible to odors and flavors. If this were not so we could not transmit lactic acid flavor into the butter.

Starters, Natural and Commercial

By the term starter in cream ripening is understood a medium containing a majority of desirable bacteria present in an active condition. Generally speaking, there are two kinds of starters, the natural and the commercial.

The commercial starter is prepared from a pure culture of bacteria, obtained in the laboratory.

The natural starters include a great many kinds of dairy products which are supposed to contain a majority of those germs which produce desirable flavors in butter. Buttermilk, sour cream, whey, sour whole or skim milk are classed under this head and may be termed natural starters.

The best natural starter is obtained by selecting a number of samples of the best milk, placing them in sterilized glass jars and allowing them to stand at 70°F. until sour. The sample which coagulates into a smooth, uniform curd, and which has a pleasant acid taste and smell is selected and used as the "mother-starter." When this is inoculated into a quantity of pasteurized skim milk, cooled to and kept at a temperature of 70°F. until it begins to coagulate, it usually will produce a starter which is equal and often superior to a commercial starter.

Commercial starters are pure cultures prepared in a commercial way. These pure cultures contain in an active condition the bacteria which produce desirable flavors and aroma. These bacteria are inoculated either into a liquid or a powder medium. The liquid medium consists chiefly of milk sugar. The liquid form will not keep long and is not safe to use after it is about nine days old. The powder cultures can be kept much longer and still retain their vitality. Glass jars have the preference as containers because any uncleanness shows through and there are no seams on the inside to corrode.

Preparation of Starters

To prepare the starter, select the best milk which it is possible to obtain. Fill a carefully sterilized quart jar to within about one inch of the top. Pasteurize by setting the jar in water and applying heat until a tem-

perature of 145° Fah. has been reached. Hold at this temperature for 30 minutes. Then cool to 40° Fah. and hold there until the following day. Label this bottle No. 1. Examine the milk, being careful to use only sterilized utensils. If the milk is free from foreign odors and is sweet, pasteurize it again and handle the same as the previous day. Start bottle No. 2 and care for it as you did for No. 1.

On the second day examine bottles No. 1 and 2. If you find No. 1 still fine it is evidence that it is fit for another series of pasteurization. Cool to 80° Fah. Then inoculate it with $\frac{1}{4}$ of a small, or standard size bottle of prepared culture. After the culture has been added shake the bottle well to distribute thoroughly and evenly the cultures through the milk. Place the bottle in the incubator and let stand two hours. Then cool to 70° Fah. and hold until it shows an acidity of .8 or .9 per cent.

Do not disturb the bottle until you are sure it contains the right per cent. of acidity and is smooth and creamy. Then cool it down as low as 40° or 36° Fah. Proceed with bottles No. 2 and No. 3 until they have each had their series of three pasteurizings. Skim off the top of bottle No. 1 with a sterilized spoon and discard. Inoculate bottle No. 2 from Bottle No. 1 the following day. Inoculate bottle No. 3 from whichever of the other bottles shows the best culture.

By holding the starter at the temperatures I have mentioned you have not destroyed the vitamins or caramelized the sugar content of the milk, but you have gotten away from all bouillon flavor, which is quite pronounced when used too soon and also that "puckery" taste which you get from the cultures put up in milk powder. One of these quart bottles of cultured milk is sufficient to inoculate 300 pounds of milk.

Pasteurize this milk in a small starter-can at 160° Fah. and hold 40 minutes. Then cool down to 66° to 72° Fah., depending somewhat on the outside temperature. Always use the best bottle of the three you have prepared, the creamiest, smoothest, highest aroma and flavor and containing .8 or .9 per cent. acidity, yet mild and clean. A little experience will show you just what to do and how to do it.

Many unsuccessful results from the use of starters have been reported. But, if the starter is good, it will never produce poor results.

Avoidance of Abnormal Fermentation

Many starters are used which develop abnormal fermentations, such as show an acid, bitter taste, and a slimy condition. These defects are quite common and are brought about chiefly by over-ripening the starter at a high temperature and then keeping it for a long time at a low temperature before using.

The question of under ripening is also of importance. It is a well-known fact that just about the time that milk begins to have a noticeably sour taste it has a disagreeable flavor. After more acid develops this disagreeable flavor largely disappears and the milk assumes a clean, desirable acid flavor. Storch, the well-known authority on starters, claims that this disagreeable flavor is due to the action of undesirable organisms during the first souring stage. As the souring progresses these undesirable bacteria are subdued and gradually crowded out by the desirable acid-producing types.

Milk is sweet because it contains sugar, and this sugar content is the food for the development of the lactic acid bacteria. Milk also contains casein, which is the substance from which come the inferior bacteria which are detrimental to lactic development.

Importance of the Starter

The starter room is perhaps the most important place in the whole plant, because there is no other way to obtain this lactic ferment flavor save through the starter. In this room the greatest care should be exercised in the selection of milk. If milk is contaminated with bad flavors or is too old, it is not fit for starter-making. Milk men are very apt to try to dispose of an inferior article, but if the buyer knows quality and insists upon having good milk it is usually furnished.

In the Book of Books we read: "Whatsoever a man sows, that shall he also reap." That is absolutely true in the case of starters. If the starter is off flavor in the least you may look for an inferior quality in the product. But if it contains a good body, and is a good lactic ferment, planted in clean, pasteurized skim milk, we have every reason to expect the kind of lactic flavor we have planted and we will find the results transmitted into the oleomargarine, developing the desired flavor in the process of ripening.

Good judgment and care must be exercised in pasteurization, that the vitamins are not destroyed and that the sugar content does not become caramelized. You can readily see that if the sugar content is caramelized you will have no substance for the development of lactic acid.

National Research for the Mineral Industries

To provide for our extractive industries, as represented in mining and metallurgy, the service rendered to agriculture by the agricultural experiment stations of the states and nation, is the objective of recent federal legislation which has permitted the establishment of thirteen experiment stations to aid the mining industry and to co-operate with the industry in the development of our mineral resources.

In pursuance of this work the Bureau of Mines, Washington, D. C., through its stations now has definite co-operative agreements with more than forty mining and metallurgical concerns, universities and State organizations for the solution of industrial problems, which will add to the prosperity of American mineral industries.

The work of these stations has been growing so increasingly important and so much business is being carried on with them by the industry that the stations have been reclassified and given definite names, so that there will be a better understanding of the work performed and a greater accessibility between them and the industries interested.

The name, location and special investigative functions of the several stations appear in the following table:

Name of Station.	Location.	Research Function.
Pittsburgh Ceramic	Pittsburgh, Pa. Columbus, Ohio	Coal mining. Clay ceramics and pottery production.
Central District	Urbana, Ill.	Coal of central district fields.
North Central	Minneapolis, Minn.	Low-grade Lake Superior iron, manganese and other ores.
Petroleum Experiment	Barthlesville, Okla.	Petroleum production and refining.
Southern	Tuscaloosa, Ala. (Office, Birmingham)	Local minerals, by-product coke and iron.
Mississippi Valley	Rolla Mo. (Office, St. Louis)	Lead and zinc mining and metallurgy.
Inter-Mountain	Salt Lake City, Utah	Lead and zinc; low-grade ore utilization.
North West	Seattle, Wash.	Coal production; non-ferrous mining and metallurgy.
South West	Tucson, Ariz.	Low-grade copper ores, etc.
Rare & Precious Metals	Reno, Nevada	Rare metals; gold and silver mining and metallurgy.
Pacific Alaskan	Berkeley, Cal. Fairbanks, Alaska	Local minerals. Local minerals.

Expression and Progress in the Technical Professions

A Discussion of the Methods and Problems of Making Technical Students Better Writers

By Homer A. Watt, Ph.D.

Associate Professor of English, New York University

AS a college teacher of English who had struggled for several years with the task of making technical students more articulate, I should be glad to tell you of my own problems and methods. It is my purpose to point out first the extent to which editors of technical journals are concerned with the efforts of college teachers of English composition, then to outline the training methods which the English departments of technical schools are now following, and finally to suggest in what ways the editor may assist the teacher to solve the problem with which both are struggling, that of creating a higher standard of craftsmanship in technical papers.*

The Teacher of Composition, and Technical Journalism

The service of the teacher of composition in the technical school to the editor of the technical journal is that of the drillmaster who trains the soldiers to the general who leads them into battle. It is our task as teachers to struggle with foggiest of thought and incoherencies of expression, and by pointing out his defects to the student so train him in habits of self-correction that the manuscripts which he submits later to editors will be tolerably free from the errors that have helped to make us wrinkled and gray.

Although I have no statistical evidence for the assertion, I believe that most of the contributors of substantial articles to the technical journals have been trained in professional schools. Men so trained have a feeling of membership in the technical profession; they see their own tasks in relation to the work of toiling conferees elsewhere, and so are eager to reach out and exchange experiences and opinions through the medium of the technical press. But skill in expression does not come with desire, and many of these men are handicapped by lack of experience in writing. An engineer told me only a few days ago of the comical agony of an expert in electrical meters, who was called upon to present a paper on that subject before an engineering society. This master of electrical meters knew his field thoroughly, but the task of selecting and arranging and expressing his ideas for the understanding of others was quite beyond him.

Technical men who have not been trained in literary craftsmanship as students frequently remain incoherent and clumsy in expression for the rest of their lives. In the rush of their professional work they are too much preoccupied to study the art of writing; what little skill they do acquire they gain by practicing on their associates, their correspondents, and the editors. The interest of the college teacher is in the process of training; that of the editor must be in the finished product.

Results Warrant the Effort

"Is it possible to teach engineering students to write?" an engineer asked me the other day. Yes, it is possible, just as possible as to teach them mathematics and mechanics, provided we are satisfied with humble results and do not expect our students to acquire the literary finish of a Huxley. To be sure, some of our effort will be wasted; many of our students will never write be-

cause they will always lack ideas and incentive to expression. But some will think better and write more coherently for their training, and from them our reward will come.

Among teachers of college English I have met those who profess to believe that all efforts devoted to teaching technical students to write are wasted, but I have never agreed with these skeptics. A rising young poet who was endeavoring to make a class of liberal arts students into the likeness of his own image once lampooned me in the following hitherto unpublished verses:

"Oh, Homer Watt! Oh, Homer Watt!
I pity thee thy wretched lot.
Of all the tasks beneath the sun,
I'm sure the most unhappy one,
The most unholy, Godless spite,
Is teaching engineers to write."

Now I really believe that the engineering students in the particular engineering section of freshman English that provoked the poet's satire have done more writing since their graduation than have the prom. queens and bridge whist experts and football heroes whom my lampooning friend was trying to convert into Ruskins and Elizabeth Barrett Brownings.

To skeptical business men and caustic colleagues, therefore, I have always replied that teaching composition to young men who were being trained in the technical professions is not only possible, but very much worth while.

The Systems of Teaching Composition

There seem to be at present three different systems or "schools" for the teaching of composition to technical students. These are alike in being based on analyses of essays and constant practice in theme writing, and in aiming primarily at correct and effective expression. They differ in material employed, in method of attack, and in secondary objectives. I will define and comment briefly on each.

System I

The first refuses to give the technical student special consideration. In universities in which the English department is in the college of arts, the technical student usually is put through the same mill as his brother in liberal arts, under the theory that he gets too little contact with cultural subjects and needs more. Where this point of view is sincere and the attitude of the instructor is sympathetic and understanding, such a process is hardly open to adverse criticism.

Unfortunately, however, too many teachers of English dislike to instruct technical students, and assume toward them an attitude of academic Pharisaism, to which the students are quick to respond in a cordial hatred of their work in English. I do not believe, moreover, that most engineering freshman (the course is usually given in the freshman year) can be made to see that a purely academic course in English composition has any connection with the engineering course which they insist they have come to the university to take. It may be argued that the English course is good for them, and that some day they will realize its value, but if their attitude while they are taking it is negative, not to say rebellious, it is hard to see how they can get much out of it.

*A Paper read at the Meeting of the National Conference of Business Paper Editors, Hotel Astor, New York City, October 21.

System II

The second type of course, given also usually in the first year, is especially designed for the technical engineering student. It aims, like the first, to give him training in expression and culture, but it also has the unique aim of defining for him the profession which he is preparing to enter and helping him to think of himself and his technical school education in terms of his ultimate service to his fellow-men. To this end he analyzes essays which define engineering and which comment on the value of the different subjects he is studying and on such big themes as the relation of science and literature and of "practical" work and "chamber" work; in addition he is asked to write themes based on his reactions to his reading or drawn from his personal experiences or reflections. Three collections of essays which meet the demands of this type of course have so far been edited. They are: Aydelotte's *English and Engineering* (McGraw-Hill, 1917); Eason and Weseen's *English Science and Engineering* (Doubleday, Page & Co., 1918), and Baker's *Engineering Education: Essays for English* (Wiley, 1919). The obvious advantages of this course are in its probable stimulation.

It is the theory of Professor Aydelotte, originator of the plan, that after a brisk class-room discussion of one of the essays, the class will become filled with ideas and enthusiasm for expressing them. With a sympathetic teacher, skilled in leading class-room discussions, this result reasonably may be expected. With a dull, indifferent and indolent teacher, on the other hand, these class-room "discussions" may easily degenerate into vapid and hypocritical comments by both teacher and students, and the prime object of all work in composition, instruction in writing, may be lost sight of.

System III

The third type, usually given, I believe, after the first year, is frankly professional in aim. On the assumption that the great majority of technical professional men are likely to write more technical descriptions, explanations of processes, reports and business letters than any other kinds of composition, the students are trained in these forms. It should not be understood that the student themes are highly technical or complicated, but simply that the student is doing the same kind of writing as is the professional technologist; his explanation of how he wired his house, and his description of the chemical laboratory differ only in degree of difficulty, not in kind, from the papers of his seniors.

The advantages of this method of drill are in the interest which it arouses in the student, who is made to see at once the relation of English to technology, and in the direct application of his training in English to his practice. Shortly after I had introduced a course of this type in the junior and senior years of the engineering school of a large Middle Western university, I was told by one of the engineering instructors that there was a noticeable improvement in the quality of the senior reports and theses. The disadvantages of the course arise from the difficulty of securing instructors with a sympathetic point of view and a willingness to do the work painstakingly and thoroughly, and from the danger of binding the student too narrowly to his technical interests. To avoid this latter danger, I believe that the course in technical writing should follow, not supplant, the cultural course in English composition. The special texts which have so far been prepared for courses in technical writing are: Earle's *Theory and Practice of Technical Writing* (Macmillan, 1911); Sypher's *Handbook of English for Engineers* (Scott,

Foresman and Co., 1913), and my own *Composition of Technical Papers* (McGraw-Hill, 1917).

Methods of the Teacher Under System III

I have taught English composition to technical students under all of these systems, but since editors of technical journals are interested chiefly in technical papers, I will outline some of the aims and methods which have guided me in giving courses of the third type. It should be understood that many of these are applicable also to the other types of instruction which I have enumerated.

First let me sketch the general objectives of a course in technical writing. English is regarded frankly as a tool, and students are taught to understand its value as a tool and to think of written expression as natural and not unusual even for technical men. An effort is made in the course to bring the prospective technical men to regard the technical journals as a great unfinished but ever growing encyclopaedia of technical knowledge, in the making of which it is at once their duty and their privilege to assist, and through which they may touch elbows with other workers in their great professions.

Through their theme writing they are given fundamental training in logical thinking; they are taught to make careful, conservative statements, to avoid wild generalities and *post hoc, propter hoc* fallacies, to test the validity of their evidence and its applicability to a given conclusion, to indicate the limits of possible error and alternative solutions which should fairly be considered—in brief, to draw tighter the meshes of their thinking.

They are trained further to keep constantly in mind the point of view of their readers, to remember that ideas and facts which may be perfectly clear to writers who are technical men may not be equally clear to laymen. They are frequently instructed to write an explanation or a description as it should be presented to technical men, then to city councilmen, then to farmers, and they are graded on the skill which they show in selecting their facts and adapting them to the intelligence and special interests of their particular audience.

In teaching technical students to write themes, I have never attempted to accomplish too much; it is much better to aim at securing clear organization and correct expression than to try to develop literary style.

"All technical students," a professor of electrical engineering once said to me, "tend to think in terms of formulas." I believe that he is in general right, and I give my students compositional instructions that are definite and understandable, even if not always easy to apply immediately.

Some of these are:

- (1) Begin every paper with a clear statement of your subject.
- (2) Have a logical plan clearly in mind, and announce the new divisions of your paper as you come to them.
- (3) Proceed usually from general statements to details—not conversely.
- (4) Explain things which your reader does not know in terms of things which he does know.
- (5) Write fairly short paragraphs—not over two hundred words—each devoted to a definite phase of your subject that is stated clearly at the beginning of the paragraph.
- (6) Make sure that every sentence is as clear to your room-mate as it is to you.

Fundamentals of Instruction

The elements of the course are: Class-room talks on writing and class-room criticisms, pro and con, of student themes and published articles on technical subjects; themes which are corrected and criticized by the instruc-

tor and returned to the student for his correction; and frequent personal conferences in which the peculiar besetting compositional sins of the student are hammered persistently and relentlessly.

All of this work is accompanied by a continual drum-fire drive against bad thinking and bad structure, and against illogical statements, rambling sentences, weak reference of pronouns, misplaced sentence parts, and all the thousand and one devils of bad craftsmanship that wear out the blue pencils of worried editors. At the end of such a course, if the student does not have the style of Huxley, he can usually, at least, write more correctly and more clearly, and is better prepared to share creditably in the making of a technical journal.

Craftsmen's Co-operation with the English Teacher

Concern with the finished product has certainly not kept some editors from doing what they could to help make betters writers. I have in mind such activities as those of Mr. G. A. Wardlaw, whose address on *Literary Engineering* appeared in the *Sibley Journal* several years ago; of Mr. G. M. Wood, author of an excellent manual

for the guidance of members of the U. S. Geological Survey, and of Mr. T. A. Rickard, whose accurate and scholarly *Technical Writing* (Wiley, 1919) sets a high standard for all contributors to technical journals.

By continued insistence upon clear and correct and carefully prepared manuscripts, and even, I believe, by occasional "lessons" in composition in the pages of the journals—simple hints to authors, similar, perhaps to those published in pamphlet form by the A. I. E. E.—the editors can keep up among technical contributors an interest in high standards of literary work. And by pressure brought to bear upon the administrations of technical schools and colleges to give more work and better work in English, and by closer associations with teachers of English composition in these schools, editors may assist greatly in the training of students. Teachers of English composition in technical schools will welcome such sympathy and assistance, for, after all, editors and English teachers share this aim—that of eliminating error and gradually improving literary craftsmanship in the technical professions.

Plain Talk on Pine Stump Naval Stores Recovery

By J. F. Carter, Jr.

President, Trocart Manufacturing Co., New Orleans, La.

AT no time has there been so great a need as there is today for active, military development of the processes for extracting the naval stores, turpentine and rosin, from the stumps on the cut-over lands of the longleaf yellow pine section of the South.

Millions of acres in Florida, Georgia, Alabama, Mississippi, Louisiana and Texas were a few years ago vast forest of longleaf yellow pine. Today the greater part of the acres has been denuded of the trees, and there remains a wonderful liability—the stumps. Several years ago, as the timber was cut away, land promoters grabbed the cut-over lands at a few dollars per acre and exploited them in the North. Some sold well. But the great and serious trouble is that the prospective farmer of today isn't the hardworking pioneer that was his forebear who rooted out the stumps in the great middle west and made rich farms. Today the stumps must be removed by someone else before anyone cares to buy the land to farm.

Why should the lumber companies permit these millions of acres of valuable stumps, at present a liability, to lie unused at their very doors?

Thousands of dollars have been lost in attempts to extract the turpentine and the rosin from the stumps, which accounts to some extent for the slowness of capital to take up the subject. But those with capital who are seeking investment should also seek for the reason for all the failures. It is a very reasonable reason, a veritable truth that stands out in almost every instance of failure—the absolute lack of chemical knowledge.

Extracting the turpentine and rosin from yellow pine stumps is strictly a chemical problem. No one has the right to attack the problem, to attempt the development, without the services of a chemical engineer, or of a man who has chemical training in this subject. The manufacture of explosives and dyestuffs, of photograph films and synthetic perfumes are no more chemical processes than is this work of treating properly the yellow pine stump.

Let me get straight to the bottom of this matter at one leap. Why should anyone, be he chemical engineer,

high-grade business executive, or clerk in a small store, use time and capital in the development of any process which gets everything impure, when a mere change of plan and the addition of a little capital will bring out pure products from the same raw material?

The answer to that question is necessary if one is to really think in a straight line toward successful development of processing the yellow pine stump.

Throw destructive distillation into the discard. That descriptive word "destructive" tells the story. Train the destructive distillation process on a yellow pine stump and all the products are impure, from the turpentine to the charcoal. No control is possible, and the resinous products, along with ligneous products, come swooping over in a troop that can never be separated profitably into units. Yet people will try and try the destructive process. In days when prices were at what was known as "normal" that process was a failure because the goods did not bring the price; they were not wanted so much as purer products. And in the coming days of what we may again call "normal" that same destructive process will fail, because it should.

Steam distillation is the next process—one which takes out a large part of the turpentine, but not all; and leaves everything else behind. In the days of high-priced turpentine it may succeed; but days of high-priced turpentine are never sure, and never great in number.

How about the volatile solvents, gasoline, benzene, naphtha, carbon disulphide and turpentine itself?

First, the expense and the equipment for recovery of the solvent, and a necessary loss of a large percentage; second, and more important as attached to profit-making in plant operation, the use of the volatile solvents requires too much time.

Time is the essence of the contract which the chemical engineer has with invested capital, for time increases all the figures over and above what are known as "operating expense;" increased time makes increased overhead-per-unit. And, just after that all-important consideration of time comes the knowledge that the volatile-solvent processes do not get all the resinous products.

Seventeen years ago I started my study of the processes of extracting products from the longleaf yellow pine stump. In laboratory and in plant practice I have tried them all. To my own mind, from the viewpoint of the chemical engineer and from the viewpoint of invested capital, all these processes are really failures. There are plants making money using them—in these high-priced turpentine and high-priced rosin days. By close management and by the operation of very large plants some of them will continue making money in the use of some one of the aforementioned processes. But when the problems are tremendously increased, why not seek some quicker, easier, less costly process?

My own view of the work of the chemical engineer is not so much that he should battle and struggle and worry over the solutions of problems forced on him by the use of a stated process, but rather in the search for another process which gets the wished-for results and has less problems, and those more easily solvable; more especially if he can do so without throwing equipment into the discard and calling for more investment in new and specially designed equipment.

And, attacking the matter from that viewpoint, I have veered from the processes listed in the foregoing, and have done so with success. Laboratory tests and practical plant tests in a small-plant trial have been successful. And yet I have no great secret to withhold, no patents to apply for, no specially designed equipment to build. I am pleased to call it the "Triple Alkaline System." It gets all the turpentine as pure turpentine, a small amount of pine oil coming over in the first condensation, but later taken out by distillation; it gets all the rosin out in the form of rosin oils which again are distilled, if desired, to get the various "runs" which the market demands. The recovery of chemicals is standard; the loss is exceedingly small, and the real profit to be expected is treating the yellow pine stump is obtained. That is what capital is seeking—the profit. And in this system lies the profit.

The way is open for capital to make investment in plants of size for treating the yellow pine stump. The lumber man who owns thousands of acres of stump land may now increase the value of his land by clearing it, and make money by so doing through the turpentine and the rosin oils which he gets. As closely as I can figure it can be made better than an annual fifty per cent. dividend payer.

Already one company which neither operates a lumber mill nor owns stump-land has invested hundreds of thousands of dollars of its spare money in a plant for extracting the products from the yellow pine stump. There are scores of lumber companies which should be doing the same thing. And no more promising field is offered to idle capital, or capital seeking a really good investment, than working up the products in the stumps of the Southland.

May I again lay stress on the one main point in the entire development: It is a chemical business and the man with chemical knowledge and chemical training must be called in. And the longer he is kept in the better it will be for the invested capital. Lumber men want lumber men to run their mills; advertising agencies seek men trained in advertising to work in their offices and in the field; quarry owners desire practical quarrymen to operate their plants. So the practically trained man must be called in to develop this potentially enormous business of reclaiming millions of dollars which are going to waste by lying dormant in the yellow pine stumps of the extreme South.

Steel Cities Chemical Co., Birmingham, Ala., has increased its capital from \$150,000 to \$400,000.

The Sale of Chemical Service

To many chemists, in the fullness of their knowledge of applied science and the dissatisfactions of a present environment, comes at some time or other the project of consulting chemical practice.

Doubtless those who have established themselves in independent practice are inclined to believe at times that a steady job, with the assurance of a regular income, is not appreciated as it should be by those who hanker after a chance to relieve themselves for a consideration of the heaped-up knowledge of this multifarm art.

Where opportunity and aptitude have developed special skill of wide use and demand certainly conditions favor the establishment of a business for its sale; but merely knowing well a subject without commercial instinct or experience, or connections in the industry that can be capitalized, is an unsafe craft in which to embark on this uncertain sea.

Men who have developed successful organizations, or who have acquired a dependable clientele, admit the up-hill work of their early effort and marvel at the temerity which their determination translated into success.

However great may be the advantage of special skill or exceptional knowledge or ownership of a desirable process, or control of essential apparatus, salesmanship plays an important part in the unfolding drama of the consulting chemist; some who have returned to factory jobs may characterize the experience as a tragedy.

Out in Los Angeles, Arthur R. Maas, who graduated in pharmacy from the University of California, and whose Master's degree from the University of Southern California was a stepping stone to the professorship of pharmacy in that institution, has built up a consulting and service organization in industrial chemistry whose list of clients indicates a commendable measure of success in this field.



FROM TEST TUBE TO FACTORY.

(From "Chemistry and You")

Dr. Maas, in a 26-page, 5 x 8 booklet, entitled "Chemistry and You," seeks to enlarge his clientele by addressing this particular message to those who would buy his service if they knew how to use it. In this booklet he seeks to educate a new class of customers to an appreciation of the service of the commercial chemist. He emphasizes his talking-points by cartoons, and this without a sacrifice of dignity, and with a degree of effectiveness that puts his message across.

While some chemists may think Dr. Maas is a little too elementary in his sales-talk, there is no question but that he has contributed a unique example to the subject of salesmanship of chemical service.

The Dold Packing Co., Buffalo, N. Y., has been incorporated for \$1,000,000, and has leased the plant of the Skinner Packing Co., of Idaho, Neb., where it will manufacture the Skinner brand of products in addition to its own. Ralph Dold, son of the president of the Dold Packing Plant, will have charge of the Omaha plant.

Sanitary Control in Food Inspection

By J. H. Knapp, M.D.

City Chemist, in Charge of Food and Drug Inspection, Cleveland, Ohio



J. H. KNAPP, M.D.

City Chemist, in Charge of Food and Drug Inspection, Cleveland, Ohio.

It is not the purpose of the author to advance new theories on the subject of sanitary control in food inspection, or to lay claim to any originality, but merely to state the method of control as carried on in the City of Cleveland. However, it is aimed to bring out points of divergence from methods employed in other cities.

Organization

The City Chemist is in charge of a subdivision of the Health Department and is answerable to the Commissioner of Health as well as the Chief of the Bureau of Laboratories. He is charged with the enforcement of food and drug laws as well as sanitary control of food handling establishments except slaughter houses and dairies which

latter are under the control of a veterinarian. In addition the Department of the City Chemist handles the analytical work of other city departments and also renders testimony in court in police cases.

Personnel

The personnel consists of eight laboratory assistants, six of whom must be graduates in chemistry, six food inspectors and two stenographers. One of the chemists is a pharmacist and handles drug inspection and all analytical work connected with it. The food inspectors are sanitary officers with full police powers, who have been detailed to work under the orders of this office. Thus a man having no previous experience in food inspection is taken and instructed in the essentials of food inspection and sanitation and their relation to public health. It is, therefore, evident that judgment must be exercised in the proper selection of men, in order to obtain officers of the necessary personal and mental qualifications. Thus it is obvious that there is a close relation between inspector and analyst due to the fact that both inspection and analysis are carried out under the supervision of one official, i.e., the city chemist.

Classification Work

The actual work assigned to the department consists of the control of all food handlers except dairy and meat producers which latter are under the control of a veterinarian as before mentioned. For convenience sake this mass of work is divided into two classes, viz., routine and special or seasonal.

Class I

Class I consists of the regular inspection of groceries, restaurants, bake shops, confectioneries, candy factories, markets, fruit dealers and drug stores. These in-

spections are made continuously throughout the year, each group being taken up a time, by one group of inspectors. Inspectors are changed in districts regularly so that one man may not be inspecting a certain group of dealers continually and thus imputation of unfairness or graft is avoided.

Class II

Under Class II, special or seasonal work is included. Railroad terminal inspection of incoming food shipments and tracing to point of distribution, bottling works, candy factories, canneries and the handling of complaints of citizens. One inspector is assigned to the railroad terminals and it is his duty to inspect all incoming shipments of food, both as to purity and also as to proper labeling. These shipments are all traced to the local distributors where proper samples are taken and submitted to the laboratory for inspection and analysis. In case of a perishable food in a bad state of preservation, condemnation or salvage is enforced at once by the officer who is inspecting before release for distribution is allowed.

Bottling works, candy factories, and canneries are inspected more frequently through the periods of their seasonal activities. The chief inspector who remains at the office handles all complaints of citizens and assigns the other inspectors to their various routes.

Sample Collection

At this point it is appropriate to mention something in regard to sample collection in such a system. The sources of these are as follows: (1) routine inspection at terminals of incoming shipments; (2) routine field inspections; (3) collection upon orders of the City Chemist in special investigation; (4) complaints of citizens. It readily may be seen that there is necessarily at all times an abundance of material for the efforts of the analytical force.

Procedure

A typical routine of procedure in the operation of sanitary control upon food handler, wholesaler or retailer or manufacturer would be as follows:

The uniformed inspector would make his inspection as to sanitary conditions of the establishment, noting at the same time purity of products handled and also proper labeling. Orders are then issued, upon an official slip signed by the Commissioner of Health to the owner, to correct any violations noted within a specified time. At the termination of the time given to comply with orders, a reinspection is made by a different inspector and if conditions warrant he recommends a summons to the office at which time a warning is given by the chief inspector.

If upon subsequent inspections violations are noted, a summons to police court is sent out, which results in a warning by the prosecutor. Further violations are punished by either one or two methods, viz., arrest, or closure of the establishment, or both. In a temporary closure the inspector or a precinct patrolman stands guard at the entry until necessary orders are complied with. At any time an officer may close an establishment upon his own initiative, when sanitary conditions warrant, by informing the office of conditions.

It is appropriate at this time to state that the office always makes special efforts to publish through the medium of the press all convictions of food handlers

for violation of sanitary laws. Furthermore, this office has always found, temporary closure of a business with appropriate notoriety is an effective method of enforcing sanitary laws and has a restraining influence upon other possible law-breakers in the same or similar lines. Some time ago, a prominent hotel was temporarily closed by this office and an officer was stationed at the door to prevent the conduct of business until the place was properly cleaned. As may be imagined the operators lost no time in cleaning up, in order that the ban might be lifted.

Another effective measure in our hands is the use of score cards which may be posted by the proprietor. For example in a restaurant a white card signifies, ninety per cent. or better; blue, eighty to ninety; red, signifies, eighty or below. As a result of judicious notoriety patrons are in the habit of looking for white cards and shunning the red. Several restaurant proprietors have erected model establishments in the effort to obtain perfect records of 100 per cent.

Effective Means

Still another effective measure of public health which has been a great aid to our department, is the holding order, which is oftentimes issued in the case of grossly misbranded or adulterated goods. This order operates as follows: An inspector observes the condition of the stock and collects representative samples which are immediately analyzed or investigated. At the same time upon telephone orders from the city chemist a written order signed by the Commissioner is issued to the seller to hold this certain amount from the market until ordered released by the City Chemist. Upon thorough analysis and investigation, salvage or destruction or release is ordered.

Cooperation

It has been the policy of our office to cooperate to the greatest practical extent with other agencies inaugurated for the public welfare. Our inspectors have been instructed in the technique of preparing federal samples and whenever possible any violations of the Food and Drugs Act is reported to the federal authorities with complete evidence as to analytical findings. Furthermore, in my opinion such cooperation is one of the greatest aids to the municipal drug official in food enforcement and should be used even at the sacrifice of a gratifying local conviction against an offender.

Federal Bureau

To be sure judgment must be used by the official as to the extent of guilt chargeable to the local dealer. Our department in Cleveland cannot commend the Federal Bureau officials too highly for their splendid cooperation and aid to us by their vigorous action against offenders from other states, evidence concerning whom, we originally furnished to them for consideration. In many instances we would have been unable to have coped with our local problems so effectively, had it not been for the gratifying aid of the Federal Bureau. On the other hand we have felt it a duty to extend our efforts to report conditions, the correction of which would benefit the community at large.

Federal Seizure, etc.

In case of federal seizures and condemnations or prosecutions our officers have always cooperated in the actual performance. Our cooperation is extended to the state department of agriculture, but as a rule, this agency is not called upon so frequently as the federal agency, due to the fact that most cases involved are interstate in nature.

Cooperation is established between both the State Board of Pharmacy and Medical Board and bonafide inspectors of these two agencies are detailed to our office for work in conjunction with us.

Cooperative Trade Agreements

Finally the Office of the City Chemist has established cooperative agreements with the local papers and most of the various trade associations, and in most instances the City Chemist is a member of their respective advisory councils. As a result of these latter arrangements, many cases of violations have been satisfactorily arranged out of court with resulting justice to all. From time to time circular letters embodying regulations and decisions, are sent out to the various trade associations, for their instruction and benefit.

Effectiveness

In our own opinion, there can be no doubt as to the effectiveness of our activity in sanitary food control under the present organization, which has existed as such for about four years, especially if this system be compared to the old previous arrangement, i.e., the separation of inspection from laboratory, each under separate heads.

The following improvement in results is notable under the present system:

(1) Work is greatly simplified and effective food inspection, both as to misbranding and adulteration, is obtained at the same time that sanitary conditions are inspected.

(2) Inspectors are taught by one competent—a food chemist—the relative values of food and sanitary inspection.

(3) Closer relations between chemist and inspector are established and more concerted action in food control results.

(4) Greater powers to municipal food officials in enforcing regulations due to the greater police powers of the officer utilized as inspector in cases of emergency.

(5) Avoidance of unnecessary duplication in inspectors and resulting lesser expense to the public purse.

(6) Finally the number of arrests, prosecutor summons and condemnations has decreased approximately fifty per cent. within the past four years.

This last point in my opinion illustrates the moral effect of concerted action in the accomplishment of food control, since our office has found that the trade very readily cooperates with the health division knowing as they do that all bonafide complaints or appeals are heard by an official who is intimately acquainted with details of inspection, sanitation and analysis.

Conclusion

In conclusion, I am forced to admit that mutual intimate knowledge of chemist and inspector in regard to the history of samples and their collection may be a dangerous weapon in the hands of an unscrupulous man, but in Cleveland, we have yet to find a case where this knowledge has had the slightest influence upon the findings of analyst or inspector, nor has the charge of unfairness ever been made against the department. In fact experience has shown, that in any probable legal prosecution both analyst and inspector are more careful in their work and in the handling of samples. The City Chemist personally decides the disposition in each case and also assumes full responsibility for it and thus both analyst and inspector are relieved from that much worry in reporting their results.

Our system has likewise taught us that through this intimate connection between analyst and inspector the latter being supplied with a fund of information which ordinarily a chemist only possesses, is better able to represent the office before both trade and public.

Lastly if a high standard is maintained by the head of the department in his relations with the trade and also the best possible men selected for the work, no charge of favoritism will be made by the trade against this official.

Refining Problems of the Petroleum Industry

By H. H. Hill

Chemical Engineer, Bureau of Mines

THE wide publicity that is given to the discovery of new oil fields has led many people to believe that our supply of crude petroleum is practically inexhaustible and that in order to keep pace with the demand for petroleum products it is only necessary to drill a few more wells in some of the south-western states. It is not generally realized that, although many famous fields have been developed in Oklahoma, Kansas, Texas and Louisiana during the past few years, the production of crude oil in 1919 was not sufficient to meet the demand and it was necessary to import approximately 53,000,000 barrels from Mexico.*

Continued efforts are being made to recover a larger percentage of the oil underground by improvements in methods of drilling and in handling producing properties. Improvements are also being made in methods for handling the oil after it has reached the surface, which will result in reducing losses through leakage and through evaporation. These methods for cutting down waste in production and storage, if universally adopted, will no doubt result in appreciable increases in our supply of crude oil.

Present indications, however, point to the fact that in the future, production of crude oil will not increase much more rapidly than it has during the past few years, while there is every reason to believe that the demand for petroleum products is only well under way. It is therefore evident that, since the supply of crude is approximately a fixed quantity, increasing or decreasing by only a few per cent. each year, the burden of supplying the increased demand for petroleum products rests on the refiner, who must improve his methods of refining to such an extent that larger yields of the products in greatest demand can be obtained from a given amount of crude oil. The refining industry is aware of the importance of its position, and progressive refiners are making every effort to increase the efficiency of their plants. There are, however, a number of problems that must be solved before the industry can operate to maximum advantage.

Types of Refineries

The problems encountered in the refining of petroleum differ greatly with different crudes and with different types of plants. The difficulties encountered in the manufacture of lubricating oils from California crude are, for example, of an entirely different nature than those encountered in the manufacture of lubricating oils from Pennsylvania crude; in the first case the chief problem is the removal of large percentages of asphaltic material, while in the second it is the separation of paraffin wax. The problems also differ with different types of refineries, and for that reason it may be desirable to briefly discuss the different types of plants as related to the production of various petroleum products, since the problems of each plant are more or less governed by the products that it manufactures.

Depending on the class of products manufactured, the refineries in the country may be grouped under four general heads: topping plants, skimming plants,† complete refineries, and refineries with cracking plants.

Topping Plants

In California and in Mexico certain of the heavy crudes are used directly as fuel oil, while others contain small amounts of comparatively light fractions that must be removed in order to obtain fuel oils with satisfactory flash points. For the purpose of removing these lighter fractions, a class of refineries usually referred to as "topping plants" are generally employed. In this type of plant the oil is sometimes heated in conventional horizontal crude stills, but in most cases the stills in plants of this nature are made up of coils of pipe, through which the oil is passed continuously. The chief product of such plants is fuel oil, although the distillate or "tops" contain varying amounts of either gasoline, naphtha or kerosene, depending on the crude oil used. This distillate is sometimes refined at the plant and used for blending with casinghead gasoline, but is frequently sold to other refineries. "Topping plants" are in many cases operated by producing or pipe line companies for the purpose of dehydrating the oil or for removing the lighter fractions prior to sending the oil to storage for long periods of time.

The problems encountered by this type of plant are, therefore, problems relating to the dehydration of heavy crude oils and production of fuel oil, rather than those encountered in the refining of distillate products.

Skimming Plants

A type of plant that is very common throughout the Mid-continent region is that known as the "skimming plant." As the name indicates, plants of this nature remove only the lighter fractions from crude petroleum and are not concerned with the manufacture of products from the heavy residues. Plants of this character are usually found adjacent to producing fields, and since gasoline is their most important product, are usually located in districts where crudes of high gasoline content can be obtained. In many cases they are later changed into complete refineries, for by the addition of rerun stills and equipment for the removal of wax and for treating and filtering the heavier distillates, plants of this nature can be converted into refineries capable of manufacturing lubricating oils.

Skimming plants produce gasoline, naphtha, kerosene, gas oil and fuel oil. The operator of such a plant is therefore interested in problems relating to the production and refining of light oils and is not concerned with lubricating oil problems.

Complete Refineries

Refineries that manufacture lubricating oils in addition to the products turned out by skimming plants are generally referred to as "complete refineries." Practically all the large plants in the country and a number of the small refineries, particularly those in Pennsylvania, belong to this class. They are, in most cases, located at the terminals of trunk pipe lines or are operated by companies that control production and are thus assured supplies of crude for a comparatively long period of time. The problems encountered by plants of this type relate

from the standpoint of plant equipment and in the relative importance of the products. In this paper the term "topping plant" refers to the type of plants that are employed primarily for the production of fuel oil, and the term "skimming plant" to those that are operated for the production of gasoline and other light distillates, in which case fuel oil could be considered as a secondary product.

*Published by permission of the Director of the Bureau of Mines.

†The terms "topping plant" and "skimming plant" are sometimes used interchangeably, the former being in accord with California usage and the latter in accord with Mid-continent usage. There is, however, a real distinction between typical plants of each class, both

to the production and refining of a wide range of petroleum derivatives, including oils and paraffin wax, in addition to light oils handled by "skimming plants."

Refineries with Cracking Plants

Plants in which gasoline is produced by decomposing heavy fractions, such as gas, oil and fuel oil, under heat and pressure are commonly known as "cracking plants." In a few cases plants of this nature are operated in connection with skimming plants, but in most cases they are operated in connection with complete refineries. Refineries with cracking plants are therefore concerned not only with problems connected with the production and refining of light oils and lubricating oils, but in addition are confronted with the numerous problems that are encountered in the manufacture of gasoline from heavy oils.

Some of the most important problems encountered in the refining of petroleum are of a general nature and apply to the production of all products. There are, however, a number of special problems that pertain only to the manufacture of each of the different products. For that reason it seems advisable to consider, under separate headings, the problems relating to the manufacture of each of the five major products derived from petroleum.

Gasoline

In the case of gasoline, the chief problem to be considered at present is that of increased production, as the question of quality, although important, is more or less controlled by supply and demand. The three methods for increasing production that at the present appear to offer the greatest possibilities are: lowering the volatility, increased efficiency in refinery operations and a more universal use of the cracking process.

Increased yields of gasoline have in the past been obtained to a large extent by cutting deeper into the crude and including in the gasoline cut certain fractions that were formerly included in kerosene. This has resulted in gasolines of lower volatility or, in other words, higher end points. The extent that the volatility of gasoline has been changed when it is considered that only a few years ago the average end point of motor gasoline was below 400°F., while a recent survey made by the Bureau of Mines has shown that the average end point of products now marketed in seven large cities in different sections of the country is 456°F. It is a question how much higher the end point can be raised before the product will become unsatisfactory for use in the present type of automobile engine. One thing is evident, however, and that is, if the end point of gasoline is raised much above the present figure it will be necessary for the refiners to increase the percentage of highly volatile fractions. This is at present being accomplished by adding casinghead gasoline. Therefore the refiner who desires to increase the yield of gasoline by cutting deeper into the crude is confronted with the problem of obtaining supplies of casinghead gasoline.

The yield of gasoline can be appreciably increased by improvements in refinery operations. As approximately 80 per cent. of the gasoline produced is obtained by straight distillation of crude oil, an increased efficiency of only a few per cent. would add millions of gallons to the gasoline supply. One method of increasing the efficiency of gasoline recovery is by the use of dephlegmators or fractionating towers. Most of the large refineries use fractionating towers on both crude stills and steam stills and as a result are able to obtain the maximum yield of gasoline from the crude without impairing the quality of the product. A large number of the small refineries do not make use of any fractionating equip-

ment, and in order to obtain gasolines with satisfactory end points, the cut for gasoline is frequently made before all fractions that could be included with gasoline have distilled off. It is believed that a general use of efficient fractionating towers would allow refiners to obtain considerably larger amounts of gasoline without increasing the consumption of crude or raising the end point of the product.

Another means for increasing the yield of gasoline is by recovering it from the uncondensed still vapors. An appreciable amount of gasoline is not condensed when the vapors from the stills are passed through an ordinary condenser. A few refineries have installed compressors or absorbers for recovering this uncondensed gasoline, and in some cases report yields as high as 2 per cent. of the crude distilled or approximately 6 per cent. of the total gasoline production of the plant. A large percentage of the refineries, however, have not made provisions for recovering gasoline by this method, but continue to burn this valuable gasoline fraction under their stills and boilers.

The quantity of gasoline that can be produced from a given amount of crude could be appreciably increased by a more general use of the cracking process. The Burton process, since it was first installed on a commercial scale, has produced approximately 40,000,000 barrels of gasoline from heavy distillates and has thus saved approximately 150,000,000 barrels of crude that would have been necessary to produce an equivalent amount of gasoline. A number of other cracking processes have been patented and a few are operating on a commercial scale, but those now in operation, including the Burton process, are using distillate oils or comparatively light residuums as crude materials. One of the most important problems in the refining of petroleum is that of producing gasoline from heavy residuums, and a cracking process that could handle such oils satisfactorily would almost revolutionize the refining industry. The heavy oils of California, Mexico and the Gulf Coast and the residual fuel oils now marketed by Mid-continent refineries could be made to yield enormous quantities of gasoline if a method could be developed by which they could be economically utilized for gasoline production. There is probably no refining problem that has been the source of so much laboratory and experimental work as the production of gasoline from heavy residual oils, and although small scale operations have been encouraging in many cases comparatively little gasoline is now made from oils of that character.

Kerosene

For the present, at least, the problems of increased production of kerosene is not one of major importance. In the early days of the refining industry, methods for increasing the yield of kerosene were the most important problems confronting the refiner, but in the past few years it has been possible to obtain larger quantities of kerosene than the market demanded. In 1919, due to the large quantities that were exported to countries that had obtained limited supplies during the war, there was a decided demand for kerosene, and stocks were depleted to a certain extent. This condition evidently was temporary, for during 1920 stocks have been accumulating and there has been a considerable change in the export market.

Although the refiners are evidently experiencing little difficulty in meeting the present demand for kerosene, the kerosenes of today are somewhat heavier products than those marketed a few years ago, and are somewhat more difficult to treat, both for odor and color. There is also the problem of manufacturing products of the

proper viscosity to give satisfactory service in the ordinary wick burners. Due to the fact that increasing amounts of the lighter kerosene fractions are being included in the gasoline cut, it may become necessary to either divert certain of the heavier fractions to gas oil to produce kerosenes of satisfactory viscosity or to slightly modify the present types of burners to permit the utilization of heavier products.

Lubricating Oils

The production of lubricating oils has always given the refiners more or less difficulty, due largely to the fact that the different process must be very carefully controlled in order to insure uniform products. There are crudes found in very limited quantities that are used as lubricants after having been reduced and filtered. Others, such as Pennsylvania crude, that contain very small percentages of asphalt can be converted to lubricating oils by removing part of the wax, reducing and filtering. Other crudes, such as those obtained from the Mid-continent, California and Gulf Coast fields, must be subjected to special treatment to produce lubricating oils free from asphaltic material.

Although the demand for lubricating oils has been increasing, there are no apparent possibilities of a shortage, except in the case of special products. There is, however, a scarcity of the grade of lubricating oils known as cylinder stock. These oils are residual products in the distillation of petroleum, are of high viscosity, have high flash and fire points and are used for lubricating the cylinders of steam and gas engines. They are also used for blending with other stocks for the manufacture of automobile engine oils. The straight paraffin base oils, such as the grade known as Pennsylvania crude, are particularly suited for the manufacture of cylinder stocks, as it is not necessary to treat the reduced crude with acid in order to remove asphaltic material.

Some of the Mid-continent crudes make satisfactory cylinder stocks, but it is necessary to subject the crude to a chemical treatment before it is reduced to stock. This, of course, increases the cost, and unless the process is very carefully controlled, the product is not always satisfactory. Although cylinder stocks are now made from some of the Mid-continent crudes, and others tested have given encouraging results, nevertheless one of the chief problems before the refiner today is the manufacture of cylinder stocks from crudes other than those produced in the Appalachian field.

There are numerous other problems in the production of lubricating oils that are of prime importance to the refiner. Conditions for treating and filtering differ entirely with different crudes and experimental work should be done to determine the best methods for handling each type of crude. The color of lubricating oils is a property that should be carefully studied to determine its importance as a means of judging quality. The problem of obtaining uniform products is one of utmost importance, particularly with reference to such properties as flash, viscosity and cold test.

Gas Oil

During the past year artificial gas plants have been encountering considerable difficulty in obtaining supplies of gas oil. This product until recently was comparatively cheap and could always be obtained in adequate quantities. The increased use of artificial gas has no doubt been largely responsible for the shortage, although the high price of fuel oil has doubtless cut down on the production of gas oil to a certain extent. Another possible reason for the shortage has been the increasing quantities used in the production of gasoline

by cracking processes, as the amount used for this purpose has practically doubled during the past three years.

The problem of increased production of gas oil is purely an economic one, for adequate quantities can be obtained provided the difference in price between gas oil and fuel oil is sufficient to warrant the increased cost of production. It is questionable, however, whether it would not be advisable for the gas companies to make use of the lighter residual fuel oils, in that way reducing the cost of their raw material and at the same time permitting the utilization of gas oil for other purposes, such as the production of gasoline by cracking processes.

Increased production of fuel oil cannot be obtained except at the expense of other products that are more valuable, namely, gasoline, gas oil and lubricating oils.

It is believed, however, that the fuel oil now produced can be sacrificed to better advantage than the production of other petroleum products.

At present the problems that are of considerable importance in connection with the production of fuel oil are: Methods of reducing the sulphur content of oils that are exceptionally high in sulphur, and methods for reducing the viscosity of the heavier fuel oils.

Miscellaneous Problems

Only a few of the problems encountered in the production of the five major products from petroleum have been considered and no mention has been made of the problems connected with the manufacture of the numerous products that are manufactured in comparatively small quantities. It is also impossible in a paper of this nature to discuss the large number of problems encountered in refining that are more or less related to the production of all petroleum products. A few of these that may be mentioned are: Fuel economy, improved insulation, improvements in treating methods, increased efficiency in filtration, methods for handling emulsified oils, recovery of sulphuric acid, manufacture of by-products from still gases and from acid sludge, etc.

Conclusion

It may be stated that all problems that have been considered are of minor importance when compared to the major problem that confronts the refiner today, that of obtaining adequate quantities of crude oil. The production of crude oil has not kept pace with the demand for petroleum products, and as a result, those refineries that were built near producing fields and at the time of flush production are encountering numerous difficulties in obtaining sufficient crude to keep their plants in operation. In spite of this condition, refineries under construction on January 1, 1920, will increase the refining capacity by approximately 17 per cent. When it is considered that the increase in the production of crude oil for 1919 over 1918 was only 8 per cent., and that even at the beginning of this year the refineries then in operation were capable of running more crude than is produced in this country, it is almost a certainty that the problem of obtaining supplies of crude will become of increasing importance. The larger refineries that are built at the terminals of trunk pipe lines or those that have their own production will not be notably affected, but the numerous skimming plants that now surround the older producing fields will have a difficult problem to face. There will doubtless be a number of cases similar to those that are now attracting particular attention, where refineries within a few miles of the famous Cushing Pool in Oklahoma and built at the time of maximum production in that field, are either shut down or are obtaining their supplies of crude by tank car from fields located in Texas and Louisiana.

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A Consolidation of
The Chemical Engineer
and Chemical Age



IN the physical measurements of conscripts in England's military mobilization during the war was disclosed an unconsidered aspect of a differential that contributed to the supremacy of British sea-borne commerce.

However true may be the charge that English industry raised a breed of stunted men as a by-product of her economic overlordship, the analogy should not be lost on American life and industry in what concerns its own perpetuation and capacity for growth.

With the spendthrift spirit of democracy we scatter heedless largess to those who need it least and in a way that only can demoralize the class and distress the people.

To the just importunities of the service-producing class who scorn to capitalize their strength into instruments of oppression, we turn a callous front, with the result that the quality of the noblest profession suffers not only in the reduced efficiency of residual inferiority, but in the quality of the product.

The teacher, all along the line from the primary school to the graduate university, is financing American growth in his unrequited contribution to the education of American youth.

THE president of Drexel Institute heads a movement to enlist the co-operation of industry with the technical school, whereby the material passed on to the college from the secondary school may be shaped into managerial ability with maximum efficiency in the process and with maximum results in the product.

It is futile to expect every technical graduate to be an embryo genius.

The demand for constructive ability is so great and the need so urgent as to compel the unlimited co-operation of industry which requires it with the educational mechanism which trains it.

Industry for its own salvation must cultivate this most promising source of material for industrial leadership.

WE are a manufacturing nation. With the encroachment of manufacture upon agriculture has come a realization, absent a generation ago, that as a nation we can sell only as we buy, for otherwise how will our exports be paid?

The heritage of war is an indebtedness abroad that can be paid only by the debtor's goods which connote his industrial rehabilitation.

To deny him an opportunity to sell not only is to confess industrial deficiency in an era of unmatched industrial enlightenment and unrivalled access to raw materials, but to display an inconsistency that has no place in the international relationship of men.

To match competitive enterprise in the open markets of the world, the American manufacturer must look to the results of his co-operation with the teachers of technical men.

PRICE changes originate with raw materials where are felt first the conditions that determine cost of manufactured goods.

From them, price changes pursue their course in definite channels in the distributive process with a sluggish flow as the channels narrow to serve the individual consumer.

America today presents the spectacle of industry in progressive coma, as the result of the circulatory system of its economic life failing to function because of the repressed stimuli of consumption.

The interruption of co-ordination in the national service of supply means reduced production, which never means cheaper goods.

Like a clot in a blood vessel of the brain, the refusal of holders of accumulated stocks to pass on to the consumer the benefit of changes in wholesale prices benumbs our economic life and delays deflation.

PHILADELPHIA embraces in its industrial district over 700 textile concerns with a weekly payroll of \$2,000,000 and constitutes the richest single market in America for dyestuffs and textile chemicals.

Textile workers in the recent flush period dominated the industrial situation, and those of the radical stamp which comprised the mediocre workers, were active in the promotion of Soviet doctrines, which found expression in malicious derangement of production and enforced employment of incompetent workers.

To check the progress of Sovietism textile manufacturers have organized to eliminate the Reds from the industry by removing the more radical ones from the payroll and placing the remainder on probation, a procedure facilitated by the prevailing slackness of restricted production.

Philadelphia textile manufacturers mean to inculcate in seditious help the significance of the Golden Rule and the futility of force to gain the rewards of competency.

THE ability and popularity of the administrative heads of the Bureau of Chemistry and the Bureau of Mines serve little to condone a violation of American tradition sought in their desire to make the "official keeper of the American commercial conscience"—the Federal Trade Commission—the licenser to American industry of manufacturing rights under patents that scientific workers in government bureaus may be permitted by appropriate legislation to procure.

Better that the by-products of the work of government scientists, in the shape of patentable discoveries, be neglected or left to the uncertain fate of dedication to the public, than that the most dependable trait of human nature, responsiveness to reward, be tempted to make the by-product the main product, with the inevitable corollary in any event of the addition of bureaucratic government to the competition of private industry.

The current example of corrective retribution to those who, in mistaken solicitude for the public interest, would permit the triumph of the heart over the head, should instil in government scientific officials recognition of the principles that employers do not encourage the competition of their help, and that the most dependable public service is that provided by private industry.

We recognize and commend the humanitarian instincts of our friends, but respectfully submit to the American people the unwise indifference involved in the payment of a mechanic's wage to United States Government scientists and the correlative creation of a culture bed for doctrines inimical to democratic institutions.

Please read here what a contributor to *CHEMICAL AGE*, who is now president-elect of the United States, says:

"We have had too much government in business. I mean by this that on the one hand we have allowed our Government to engage too much in enterprise which it has bungled and which American business can do better, safer, and cheaper, and on the other hand we have had too much ineffective tinkering with our economic structure."

THE reorganization of German industry along lines that have been characterized as socialization is in fact far from impracticable schemes to communalize production.

It expresses the realization of the malefactor that his penalty must be paid and to do so demands the most efficient utilization of German resources.

If in the process production costs are attained that permit growth of German trade, the world's welfare demands that it be granted a fair field and no favor.

The rehabilitation of Europe, proceeding most slowly where ignorance is densest, awaits the fructifying influence of trade, which in helping profitably others to help themselves is the great educator and peacemaker.

NO obstacle should impede the exercise of compassion, but relaxation of just recompense makes a victim of the victor and establishes a harmful precedent for nations of easy morals.

Trial balloons already have been hoisted to ascertain the drift of present public opinion as regards the disposition of several hundred millions in liquid assets and securities in the hands of the Alien Property Custodian representing the sequestration of the property of Germany and German aliens in this country.

Germany's appreciation of the responsibility for the defeat of her plans for the economic subjugation of the world should impel Congressional discretion, where resides the disposition of these funds, to hold the balance straight.

NATURAL selection has its innings in a buyer's market. Its operation in the work of production means, if not the elimination of the unfit, the establishment of a condition precedent to survival in the weeding out of wasteful practices that have been tolerated only because their cost could be passed on to the consumer.

Its operation means unemployment with misfortune to the improvident as well as loss to the manufacturer.

In its elimination of the unnecessary it clears the atmosphere of the poisonous exhalations of ignorant opportunism and should bring home to every man the conviction that getting something for nothing brings only evil in its train.

It enforces in every man who appreciates his opportunity that life and growth are based on service and he who would nullify it, stultifies himself and injures all.

Its operation in re-employment means the selection of the competent; and in the resumption of operation we have a going example of the principle of that survives which serves.

Every man who has made something out of himself knows his subjection to this law and how inescapable mankind is from its operation.

THE maintenance of a progressive standard of living is in the keeping of technical men in their role of trained supervisors and leaders in the work of production. From the nature of things this responsibility can rest nowhere else. Their dereliction is inconceivable.

The recalcitrant cells of cancerous growth are represented in the vast co-operative body of organized society by elements that would destroy it to advance their own ends. They must be protected from the results of their own folly.

The press of population upon available supplies is an ever increasing incentive to the reduction of production costs that labor may have its maximum reward and that an industrial society of "laborers" may grow in material comfort and in all that its efflorescence implies.

The technical man's contribution to the work of the world demands, for the people's interest, that the production of this breed of men shall receive an increasing measure of attention.

The Citric Acid Industry in the United States

CITRIC ACID, as its name implies, occurs principally in the juice of the citrus fruits, and is chiefly responsible for the sour taste of these fruits. Commercially it is derived mainly from the juice of the lemon, although smaller amounts are obtained from the lime, bergamot, and orange. Citric acid is usually made from the inferior fruit or "cull" lemons, which have been damaged by insects, fungi, or frost, or which are misshapen, undersized or even oversized. It may be regarded, therefore, as a by-product of the lemon-growing industry.*

Uses

The principal use of citric acid is in the manufacture of beverages and effervescent salts. It is also used in the manufacture of many salts which are used in medicine, including the citrates of ammonium, bismuth, caffeine, iron, lithium, magnesium, potassium, quinine and sodium. Citric acid and sodium citrate find some application in textile printing and in the manufacture of a few dyes. Many formulas for photographic developers and toning baths contain citric acid of sodium citrate. Ferric ammonium citrate is used in the manufacture of blue print paper. Citric acid and ammonium citrate are important laboratory reagents. They are essential for the determination of phosphates in fertilizers, which ranks as one of the most important of analytical operations.

Citrate of lime is an intermediate substance obtained in the manufacture of citric acid from the fruit juices and is used for making citric acid.

As cull lemons, on account of their bulk and perishable nature, can not be shipped for long distances, the commercial practice has been for growers to deliver them to local plants for conversion into citrate of lime, which is easily made from the fruit and which is not subject to decay or deterioration during shipment and storage.

The manufacture of citric acid from citrate of lime is a relatively complex chemical operation, requiring special equipment and careful chemical control. Citrate of lime has, therefore, become an article of commerce, purchased by chemical factories specializing in the manufacture of citric acid and citrates therefrom.

Some growers prefer to ship a juice which has been concentrated by evaporation instead of making the citrate of lime.

Lemon oil, although entirely different from citric acid in chemical nature and uses, is, like citric acid, a by-product of the fruit-growing industry. It is used in flavoring extracts, perfumes, and medicine.

The chief centers of the lemon-growing industry, and, therefore, the chief sources of the by-products, are Sicily, California, and the West Indies. The industry is older and larger in Sicily than in California or the West Indies.

The proportion of the total crop which is not salable as fresh fruit, and which is, therefore, treated as "culls" for the conversion into by-products, varies greatly with the skill of the grower, the season, and the market conditions. In seasons when the fruit is plentiful and low in price, the grading may be more severe, and a larger proportion rejected as culls. In Sicily the proportion of culls converted into by-products is commonly as high as 30 per cent., and sometimes as high as 50 per cent. of the total crop.

*Abstracted from Report of U. S. Tariff Commission.

Lemon Cultivation

The Sicilians cut the fruit in two and remove the pulp from the peel by means of a single knife operated by hand. The lemon oil is then pressed out of the peel into a sponge by the aid of a simple tool operated by hand. The lemon oil obtained in this way is the highest quality hand-pressed oil. The peel is uninjured and may be candied. The pulp is mechanically shredded and the juice separated in a press. The residue in the press may be fed to cattle or goats. The juice is filtered and heated nearly to the boiling point. Finely divided chalk is then added. The citric acid present in the juice combines chemically with the chalk, forming citrate of lime, a white insoluble powder which can be readily filtered, washed and dried.

Refinements of Procedure

The citric acid content of chemically pure citrate of lime is 73.67 per cent. expressed as crystallized citric acid. Commercially the citric acid content of citrate of lime varies from about 60 to 67 per cent. The standard commercial strength is 64 per cent.

The manufacture of citric acid from citrate of lime, although simple in theory, requires careful attention to details, because the product is used chiefly in drugs and beverages and must therefore be of a high degree of purity. The citrate of lime is treated with dilute sulphuric acid and is filtered from the precipitated calcium sulphate. It is then concentrated by evaporation and recovered by crystallization. The crystals are usually redissolved, the solution decolorized by animal charcoal and chemically treated to remove traces of impurities, especially iron or lead derived from the vessel. The acid is then recovered by evaporation and crystallization.

Until a few years before the outbreak of the European war, almost the entire product was shipped from Sicily in the form of citrate of lime, and the manufacture of citric acid therefrom was carried out in other countries, especially the United States, France, England and Germany. This is shown by Table 1, which gives the exports of citrate of lime and citric acid from Italy.

Another significant fact shown by these tables is that beginning about 1913 there was a considerable expansion in the manufacture of citric acid in Italy.

TABLE 1—Exports of Citrate of Lime and Citric Acid from Italy, 1909-1917.

Year.	Citrate of lime		Citric acid	
	Quantity Pounds	Value	Quantity Pounds	Value.
1909	5,248,932	\$735,222	3,527	\$714
1910	13,834,967	1,853,092	1,764	548
1911	17,964,844	2,406,259	35,535	7,156
1912	16,931,989	2,356,354	5,071	1,662
1913	8,405,919	1,231,577	486,114	191,504
1914	12,539,324	2,063,762	1,320,114	635,626
1915	14,779,638	2,458,357	1,665,134	1,093,297
1916	16,947,063	3,441,829	2,302,925	2,016,078
1917	12,869,793	2,760,356	1,834,227	1,605,760

The figures taken from official Italian sources, are converted into American weights and currency for convenience of comparison with later tables:

Control of the Sicilian Industry

An important feature of the industry is the Sicilian method of selling the citrus products. The Italian Government created a citrus chamber or *Camera Agrumaria* to control and regulate the market for citrus products. This chamber is made up of a certain number of producers and exporters from each of the Provinces, together with representatives from the ministries of commerce and agriculture and a president nominated by the council of ministers.

Citrate of lime and citric acid are handled almost exclusively by the Camera, which fixes the prices periodically and through its agents allots monthly deliveries to buyers all over the world. It guarantees the producer a certain minimum price for his product and the Italian Government levies an export duty amounting to 1 lire per quintal (0.087 cent per pound) on all sales not made through the Camera Agrumaria. The producers deposit their output with the Camera and they are advanced 80 per cent. of the value of the citrate of lime, and the balance is adjusted when the sale is made.

Prices of Citrate of Lime

The price of citrate of lime, which in 1914 was 187.5 lire per quintal (16.5 cents per pound), was fixed at 433 lire (37.9 cents per pound) for the fiscal year 1917-18. However, these prices were subject to change by ministerial decree and in October, 1918, the price was increased to 520 lire (45 cents per pound). This price has again been increased, until at the present time (in December, 1919), 700 lire per quintal (61.5 cents per pound) was asked.

Effect of the War

The general effect of the war on the Sicilian industry was a decreased exportation of the fruit and a greater conversion to citrate of lime. This has been caused by the scarcity of labor and accordingly the inability properly to cultivate the crop and by the unsettled shipping conditions. The cost of manufacture has increased greatly, and the workmen who were being paid 3 lire for a nine-hour day in 1914, are now receiving 10 lire and up for an eight-hour day.

The Industry in the United States

The industry in the United States is divided into two distinct branches. Three firms, located along the Atlantic seaboard, specialize in the manufacture of citric acid and citrates from citrate of lime, imported chiefly from Sicily, or made from concentrated juices of citrus fruits, imported chiefly from the Dominican Republic. These firms are the Citro Chemical Co., of Maywood, N. J.; Charles Pfizer & Co., of New York; and Powers, Weightman & Rosengarten, of Philadelphia.

In California there are four firms which make by-products from lemons, namely, W. J. Bush Citrus Products Co., of National City; Exchange By-Products Co., of Corona; North Ontario Packing Co., of Los Angeles, and the United Chemical Co., of Corona.

Some of the Californian firms ship citrate of lime to the eastern manufacturers, while others make citric acid. The W. J. Bush Citrus Products Co. has been in operation for about 15 years; the others have all begun operation since 1915.

The manufacture of citric acid in the United States is shown in the following table. The figures for 1904, 1909 and 1914 are taken from the United States census. The figures for 1915, 1916 and 1917 are compiled from reports made to the United States Tariff Commission by the manufacturers:

TABLE II.—Citric Acid Manufactured in the United States, 1904-1917.

Year	Quantity Pounds.	Year	Quantity Pounds.
1904	2,265,631	1915	3,417,795
1909	2,102,256	1916	4,183,538
1914	2,729,943	1917	4,032,897

Contrast of Sicilian and Californian Methods

A comparison of the situation in Sicily and California shows several interesting differences. In California the cultural methods in the lemon groves are superior to those generally used in Sicily, and the proportion of culls is therefore much less than in Sicily. Although the

proportion of culls is variable, it may be roughly estimated at 10 per cent. in California, against 30 to 50 per cent. in Sicily. The Sicilian method of separating the peel and pressing out the oil by hand is not used in California because of the higher American wages.

In California the whole fruit pulp is put through a machine which thoroughly shreds it, and the pulp then passes to a filter press, which yields an emulsion of juice and oil. This emulsion then passes through a centrifugal separator which separates the oil from the juice. As the separation of oil and juice by this method is not perfect, the oil-fraction must be distilled to secure the lemon oil. The oil obtained in this way is not chemically identical with the hand-pressed oil and brings a lower price, since it is inferior in flavor.

The pulp secured in American practice is not suitable for cattle food, as it contains the rind, which the cattle refuse to eat. After the separation of the oil from the juice, the manufacture of citrate of lime and citric acid then proceeds as already described.

The California by-product is, however, still small compared with the American consumption. During 1917 about 6,000 tons of lemons were consumed in California in the manufacture of by-products. This is probably about one-half of the total culls available. The output of citric acid was only about 5 per cent. of the American consumption.

Mechanical Peeler

The structure of citrus fruits and their great variation in shape and size have made the mechanical separation of peel and pulp a perplexing problem. The necessity of such a device to citrus by-products development and the unsatisfactory work of the machine used at the time resulted in the invention in 1916 by research workers in the industry of the U. S. Dept. of Agriculture of the machine described herewith.*

The machine consists of four essential parts, as follows:

- (1) A rapidly revolving drum which removes the peel by a grating action on the fruit.
- (2) A spiral feed screw which carries the fruit along the drum, at the same time rotating it in a forward direction so that the peel is removed in the form of spirals
- (3) A feed table of special construction which serves as a support for the fruit while passing through the machine.
- (4) An adjustment mechanism to vary the relation of the drum, feed screw, and table in accordance with the character of the fruit to be handled and the degree of its ripeness.

The details of the machine as they appear in both perspective and cross section are shown in figures 1 to 3.

Operation

The fruit to be peeled is placed in a large box, shown in Figures 1, 2 and 3 at T, the bottom of which is a few inches higher than the top of the drum at the lower end. From this box a narrow spout, Figure 3, U, extends to the edge of the feed table. The fruit rolls into this spout and is fed by hand, one at a time, between the two lower flights of the feed screw (see Fig. 3), one being delivered at each revolution of the feed screw. The fruit is carried along by this screw in contact with the drum, which removes the peel by grating.

As soon as the fruit comes in contact with the rapidly revolving drum it tends to spin rapidly in the opposite direction, but this is sufficiently retarded by the toothed surface of the table, which supports it, so that it is acted

*Letters Patent No. 1186317. Dedicated to the public.

upon by the teeth of the drum. The toothed flights of the feed screw tend to roll the fruit forward on the table, so that the peel is removed in a series of spirals. The peeled fruit is delivered from the spout W, Figures 1 and 2.

In adjusting the machine for work the weight which the fruit presents to the drum can be changed by raising or lowering the arm H on the standard L, shown in Figure 1. By means of the wheel nut P, the table can be inclined so as to increase or decrease the angle made with the drum. The smaller this angle is the more tendency there is for the fruit to be pinched against the drum and the more severe the grating action. The wheel nut N raises or lowers the arm M, so that the table may be kept at the proper distance from the feed screw.

Future of Domestic By-Product Industry

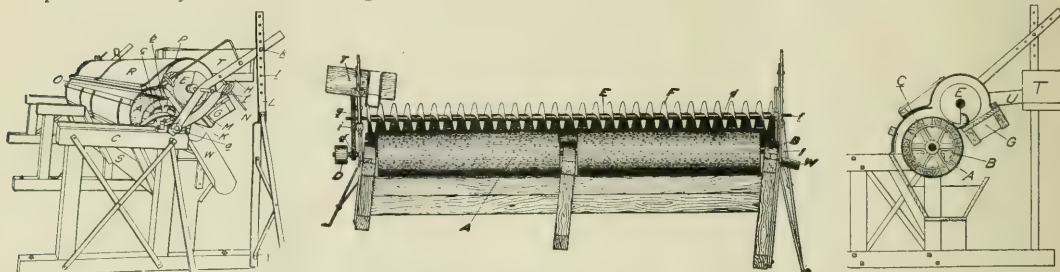
There is an opportunity for the growth of the by-product industry in California through the more com-

followed by a large increase in imports of citric acid from 8,677 pounds in 1913 to 652,210 pounds during the 1914 fiscal year and to 722,434 pounds during the 1915 fiscal year.

TABLE III.—Citrate of Lime Imported for Consumption, 1910-1919.

Fiscal year.	Rates of duty	Quantity Pounds	Value	Duties collected	Actual and computed value per unit of quantity	Actual and computed rate per cent.
1910	Free	4,114,256	\$568,175	....	\$0.138	..
1911	do.	5,219,544	712,004	....	.136	..
1912	do.	5,903,501	791,416	....	.134	..
1913	do.	5,526,954	756,309	....	.137	..
1914*	do.	562,770	85,950	....	.153	..
1914†	1c per lb.	2,557,154	410,567	\$25,571	.161	6.23
1915	do.	6,242,244	1,109,629	62,422	.177	5.63
1916	do.	8,127,364	1,763,652	81,273	.217	4.61
1917	do.	6,361,458	1,554,577	63,614	.244	4.10
1918	do.	4,013,606	814,073	40,136	.202	4.94
1919	do.	2,773,095	1,136,057	27,731	.409	2.44

*Old law, July 1 to Oct. 3, 1913. †New law, Oct. 4, 1913, to June 30, 1914.



FIGURES I, II and III. PERSPECTIVE VIEW, SIDE VIEW WITH COVER REMOVED, AND CROSS SECTION OF CITRUS FRUIT PEELING MACHINE.

plete utilization of the culls and through the growth of the lemon-growing industry. The acreage of young, nonbearing lemon groves in California is about 75 per cent. of the acreage of bearing trees, and much of the latter is in young orchards which have not reached the full-bearing stage. It may, therefore, be predicted that within five or six years the total crop of lemons will be nearly double that produced during 1918.

If the same proportion of the crop were treated as culls, and if all the culls were converted into by-products the production of by-products would be about four times as great as at present (1918). Should it prove difficult to sell the double crop of lemons at profitable figures, the tendency will be to grade more strictly, and thereby to increase the proportion of culls. It is hardly to be expected, however, that the output of by-products will increase sufficiently to supply the entire American demand.

Citric Acid Imports

The tables of imports also show that the amount of citric acid, imported as such, is small in comparison with the imports in the form of citrate of lime. Since the imports of citric acid during the years 1910-1912 exceeded the exports from Italy, it is obvious that this acid must have come from European countries other than Sicily. Under the tariff act of 1909, with citrate of lime on the free list and citric acid dutiable at 7 cents per pound, the imports of citric acid dwindled to an insignificant amount. The tariff act of 1913 put a duty of 1 cent per pound on citrate of lime, and lowered the duty on citric acid from 7 cents per pound to 5 cents per pound. These changes in duties, which occurred almost simultaneously with the development of the manufacture of citric acid in Italy (see Table I) were

TABLE IV.—Citric Acid Imported for Consumption, 1910-1919.

Fiscal year	Rates of duty	Quantity Pounds	Value	Duties collected	Actual and computed value per unit of quantity	Actual and computed rate per cent.
1910	7c per lb.	142,001	\$40,967	\$9,940	\$0.288	24.26
1911	do.	97,847	28,717	6,849	.293	23.85
1912	do.	67,332	20,275	4,713	.301	23.25
1913	do.	8,677	2,916	607	.336	20.83
1914*	do.	471	192	33	.407	17.17
1914†	5c per lb.	651,739	304,155	32,586	.466	10.71
1915	do.	722,434	447,131	36,121	.619	8.08
1916	do.	171,877	107,603	8,593	.625	7.99
1917	do.	157,528	91,463	7,876	.581	8.61
1918	do.	196,590	126,066	9,829	.642	7.80
1919	do.	680,146	632,634	34,007	.93	5.38

*Old law, July 1 to Oct. 3, 1913. †New law, Oct. 4, 1913, to June 30, 1914.

TABLE V.—Wholesale Prices, Citric Acid (Crystals), New York, 1913-1920.

	(Cents per pound, spot.)	1913	1914	1915	1916
January	38 1/2-39	51-51 1/2	55-55 1/2	59-59 1/2	64-64 1/2
April	40-41	51-51 1/2	55-55 1/2	59-59 1/2	64-64 1/2
July	44-44 1/2	53-53 1/2	55-55 1/2	59-59 1/2	64-64 1/2
October	55-55 1/2	90-95	55-55 1/2	59-59 1/2	64-64 1/2
January	65-65 1/2	72-72 1/2	125-125 1/2	90-90 1/2	84-84 1/2
April	72-72 1/2	82-82	125-125 1/2	98-98	84-84 1/2
July	72-72 1/2	82-88	98-98	98-98	84-84 1/2
October	55-55 1/2	90-95	55-55 1/2	55-55 1/2	55-55 1/2

During the fiscal year ending June 30, 1914, imports of citric acid were derived from the following sources: Germany, 57 per cent.; England, 27.7 per cent.; Italy, 12.8 per cent.; Netherlands, 1.7 per cent.; Belgium, 0.7 per cent.; and Austria-Hungary, 0.1 per cent.

A New Source of Citric Acid and Possible Substitutes

Citric acid is formed by the fermentation of sugar under the proper conditions. Considerable work, which holds much promise of success, has been done on the development of a fermentation process for making citric

acid from sugar. Although success on a commercial scale has not yet been attained there is a prospect that this process will in the near future cause a marked change in the competitive situation.

In the past the chief rival commodity or possible substitute has been tartaric acid. As tartaric acid is a by-product of the wine industry, and as the production of wine will probably decline, it seems probable that the competition of tartaric acid will in the future become less severe.

The most serious competitor is likely to be edible lactic acid, which will probably be produced in large amounts at a price substantially below the prices which have prevailed in the past.

Tariff Problems

These articles present two distinct tariff problems. The first problem is the general one, whether these articles should be placed on the free list, or subject to a duty for the purpose of raising revenue or for the protection of an American industry. The tariff treatment is necessarily related to that of lemons, the major product of the industry, which are now given a protective duty. There is, however, a difference between the two products—lemons and citric acid—in that lemons are an agricultural product with no mechanical or technical processes, whereas the manufacture of citric acid presents new technical and commercial problems.

It may be urged, further, that the full recovery of the

by-products will utilize a material formerly wasted and will strengthen the lemon industry without raising the price of lemons to the public. On the other hand, it is not likely that the by-product industry will develop sufficiently to supply the entire American demand unless the duty is made so high as to result in the use of fruit of good enough quality to be salable as fresh fruit and to exclude the by-products from abroad made from cull lemons.

The second problem is the proper relationship between the rates of duty on citrate and citric acid made therefrom. Prior to the passage of the present tariff act citrate of lime was free and the margin in favor of the acid was 7 cents per pound, which shut out the foreign acid almost entirely. The imposition of a duty of 1 cent per pound on citrate of lime did not decrease imports, and it raised over \$60,000 revenue per year. At the same time that this duty became effective there was a reduction in the duty on citric acid from 7 cents to 5 cents per pound, and at about the same time there was a development of the manufacture of citric acid in Italy. The result of these changes in competitive conditions was an increase in imports of citric acid to about 15 or 20 per cent. of the consumption during 1914 and 1915, an increase sufficient to furnish some competition to the domestic industry. During the last two years there has been a fall in imports, resulting in part at least from war conditions.

Care of Chemical Tanks and Pipe Lines

By Homer A. Hoffman

Safety Engineer, Monsanto Chemical Works

OUR first consideration is the liquid to be handled; what are its reactions, its specific gravity and viscosity. In the selection of pipes and tanks it must be known in what way they will be affected by the liquid handled, what will be the probable life of the pipe or tank, and will it in any way change its structure or give off impurities that will affect the liquid.

Structural Material

The field of selection is large and various, so that generally a choice can be made to fit the case. For instance, cast iron does very well for sulphuric acid, but not for tannins, which are best handled in copper or brass-lined tanks and pipes. A few of the materials may be enumerated: stoneware, earthenware, monel which satisfactorily resist acids and alkalies; aluminum for acetic acid; glass-coated or enameled cast iron, hard rubber and wood, all of which are used to meet certain condition. The choice of woods are cypress, redwood and long-leafed pine.

For high-pressure pipe, where the liquid necessitates costly material, cast iron pipe of sufficient strength and lined with particular material is used. Connections on all high-pressure lines must be flanged and the valves of a reinforced type. It will be found advantageous to use replaceable seats in such valves.

Placing of Underground Tanks

Underground tanks may be set vertically or horizontally, the latter being preferable for those of large capacity. A well or pit of concrete should act as a receptacle; the space between the pit walls and tank should be wide enough to allow the passage of a man at any point and the tank mounted about 15 inches above the pit bottom. This will allow for easy inspection, room for any one making repairs, and provide proper ventilation about the tank. If the tank is in too close quarters

its painting often is overlooked and its life will not be as long as expected.

The pit will withstand the action of fumes and acid far better if lined with asphalt, tar or one of the like preparations on the market. The latter, as a rule, contains a binder of asbestos or other material, which prevents its cracking or scaling off. A stationary ladder should be at the pit opening so a person may emerge without delay.

With a tank in a pit of this type a leak easily can be located, and in case of a burst or overflow the contents can be recovered and repairs can be made without removing the tank. Tanks thus placed should not exceed 10,000 gallons capacity, and should be at least two feet below the ground level or floor surface. All gauges should be placed where they can be clearly read, and all control valves, cocks, etc., should be fitted with long stems that can be turned without entering the pit and have on them locks or warning signs if any danger exists or they are likely to be tampered with. Vent pipes should end in a receptacle for that purpose.

Advantages of Sub-Surface Location

Distribution from underground tanks necessitates pumps or compression, the latter being quite satisfactory for many liquids. Any difficulties in distribution are outweighed by the fact that there is no drip, splash or spray to contend with; material would not be lost in case of a burst; valves are above the tank; it is not easily reached by fire, and, in plants where space is limited, it is out of the way.

Problems of Overhead Tanks

Overhead tanks present more problems. The location is an important consideration. If placed over passageways, which is sometimes done, a drip pan of sufficient size with a drain to a sewer or emergency tank, must be provided to carry off any liquid from a leak, overflow or burst. When placed in or on a building it must be

known that the floor, roof or building will not be overloaded when the tank is full.

Wood is used to a large extent for overhead tanks, and the woods previously mentioned will resist the action of sulphuric and acetic acids of 20 per cent. Baumé, so many of them, mostly of the open type, are found in chemical works. The failure of wooden tanks is often caused by the corrosion of flat hoops, the inner side of which cannot be seen and any defects noted. It is advisable, therefore, to use only round hoops which can be gone over from time to time. Wooden tanks should not be allowed to dry out, but if such is the case the hoops may be tightened before being used again.

Pressure tanks should be tested over pressure before being put into use. Thus a tank car of liquid chlorine would be subjected to a pressure of about 300 pounds per square inch. Such a tank will receive jolts, so it must be heavily insulated and the dome fittings encased in a hood. Switchings and siding from which such tanks are being loaded or unloaded should have a warning or lock on the switch.

In the case of all above ground or overhead tanks a hose line with a stream sufficient to drown a burst and an emergency box containing gloves, goggles, safe clothing etc., should be kept in the vicinity.

A runway or platform should be built over the tops of closed tanks so that valves and cocks can be reached from above or to one side. The chief advantage of the overhead tank is that distribution from the same is gravity.

Care of Tanks

Care in cleaning and repairing tanks is very important, and rules governing such operations should be strictly enforced. It is well to have steady crews to do such work as cleaning and repairing tanks. The accepted method of cleaning tank cars may well be applied to all other large closed tanks. The work of cleaning such tanks should be under the direction of a superintendent, and, as nearly as possible, accomplished from the outside. This can be accomplished by removing the cleaning blank and opening all drains, after which a 2½-inch hose fitted with a curved 2-inch pipe, which can direct a stream to any part of the car, is used for washing. If the pressure is not strong enough to remove sediment a hoe fitted with a long flexible handle may be used to good advantage. If there is no bottom outlet the tank should be filled enough to hold all the sediment in suspension when agitated, so that it may be pumped or siphoned out.

In cases where a workman must enter a tank it should be run full of water to exclude all gases, or a jet of fresh air run in for a sufficient length of time. Any workman entering a tank must be supplied with an approved type of respirator and protective clothing, and if the entrance is through a manhole, he must wear a belt with slings under the arms attached to a flexible cable held at the other end by a man on the outside of the tank. A jet of fresh air from a compressor or some reliable source should be run into the tank as long as there is a man inside.

If an open light or flame is used inside of the tank we use a helmet which has a hose supplying air from outside the tank, or one with a compressed air tank fitted to the helmet, which supply will last one-half hour. Proper supervision is absolutely necessary.

Pipe Lines

The same classification, viz., overhead and underground, may be applied to pipe lines. Condition of climate enters as a factor, so that underground lines are preferable in colder climates when not housed or in heated buildings. For outside use, where a number of

lines are run parallel, they should be set below the frost line in half round tile and cover, acting as a conduit with a break at intervals to serve as a drain in case of a leak or break. The tile cover not only prevents seepage, but can be easily removed for making installations or repairs.

Pipes, when set in this manner and given a coat of resisting paint, will last for a long while without showing any signs of external corrosion. An exhaust steam line may be run through the conduit, which will maintain an even temperature in winter months. For heavy pine or pipe of large diameter such installation is costly and unnecessary.

All valves, cut-offs, cocks, etc., must be clearly marked and open ends tagged to show what is being handled in the line. When compression is used to force the liquid through the lines, all connections should be flanged and the line tested before being put into use.

Overhead lines present quite a few hazards. In routing the lines care must be taken to see that those to contain toluol, benzol, alcohol, etc., are not run above or too near to motors, open flame, boilers and switches, as a drip may become ignited.

Where it is required that acid, lye or other such lines cross passageways, they should be packeted to prevent a drip or spray from falling on anyone beneath. The hangers supporting pipe should be strong enough to support the weight of a man in addition to the working load, as invariably you will find some person who will lean a ladder against, or stand on, a pipe.

All overhead lines should be marked in some way to indicate their contents. The most desirable method is that of painting the lines of different color, but where this cannot be carried out, all cocks, valves and lines should be marked in some way, and at open ends warning signs should be placed, stating what precaution should be taken or protection worn when handling the contents.

A periodical inspection should be made of all lines, and any faulty valves, leaking connections or corroded pipe be replaced, and all lines no longer in use removed. Discarded lines should be allowed to drain, or better still, be washed out, forcing water or air through them. Too often temporary lines are allowed to remain after having served their purpose. Work on lines should be done from a scaffold built on a level with the line, by persons wearing the proper safe clothing and goggles. Where a connection is to be broken it should be covered with a shield or covered with a reasonable amount of sacking or rags to absorb drips, and a warning sign hung below.

Dyers' Formulae

For use in connection with the season Shade Card of the Textile Color Card Association of the United States, whose work in the standardization of colors was discussed in October CHEMICAL AGE, the National Aniline & Chemical Co., 21 Burling Slip, New York, has issued a booklet entitled "Dyers' Formulae."

This booklet contains a series of recipes, worked out by specialists in the company's laboratories, for dyeings upon silk, cotton, wool and leather, designed to duplicate the shades that have been adopted and standardized by the association.

The effort to aid practical dyers who may be called upon to match any of the shades shown in the association's card will not fail to be appreciated. This useful publication is obtainable on request to the National Aniline & Chemical Co., whose technical staff is available to all desiring expert assistance in problems not only involving color matching, but those arising in dye-house practice.



AIRPLANE VIEW OF PLANT OF BRUNNER, MOND, CANADA, LTD., AMHERSTBURG, ONTARIO

Soda Ash Production in Canada

WITH the establishment of the plant of Brunner, Mond, Canada, Ltd., at Amherstburg, Ontario, Canada, for the first time in her history is producing in a Canadian plant the soda ash upon which so many of her manufacturing activities are dependent. Soda ash, entering as it does in one form or another into almost all forms of manufacturing activity, is recognized as a basic raw material of the utmost importance. It is accepted that no nation can be considered economically independent until it has within its boundaries a self-contained source of supply of this material.

Up to 1919, so far as is known, no soda ash had been manufactured in Canada. The Canadian use of soda ash, while small at first, had by this time reached an estimated annual consumption of between 40,000 and 50,000 tons, all of which was imported, principally from the United Kingdom and the United States.

The outbreak of the war, and the consequent extreme shortage in soda ash production which then developed, brought home to Canada the danger of her position, and steps immediately were taken, as a means of national defense and to meet an emergency, to establish a Canadian source of supply.

Brunner, Mond & Co., Limited, of England, and The Solvay Process Company of the United States, were instrumental, therefore, in forming Brunner, Mond, Canada, Ltd., and preparations were at once made for the construction of a plant to manufacture soda ash by the Solvay process.

Amherstburg, Ontario, on the Detroit River, was chosen as the site of the new plant, which is just across the river from the Detroit plant of the Solvay Process Co. Many things combined to make this a peculiarly favorable location. Unlimited supplies of salt and limestone, both needed in the process, were immediately accessible. The limestone quarries are within a mile of the plant and connected therewith by the company's railroad. An 8-inch pipe line conveys brine from wells bored to salt deposits 1,000 feet below the surface, three miles distant. The location is central, permitting of

ready distribution of the product throughout Canada, and the transportation facilities are ample. A tract of land of over 650 acres was secured and a complete modern plant was built thereon of a capacity to supply the entire Canadian requirements, so engineered and constructed as to permit of readily increased production as the demand warrants.

In spite of the unprecedented high cost of materials and labor and the extraordinary difficulties of construction then prevailing on account of war conditions, the importance of furnishing Canada with her own supply of soda ash was considered so paramount that every sacrifice was made to effect an early completion of the plant, although the cost was tremendously increased through its construction during that period.

It has been the purpose and policy of Brunner, Mond Canada, Ltd., consistently carried out, to make this plant purely Canadian in fact as well as in name. To as great an extent as possible the materials entering into its construction were Canadian, bought in Canadian markets and preferably of Canadian manufacture. The plant was completed and started production in the fall of 1919.

The product of this plant has met with such ready acceptance and sale that already additional installation is going in to increase still further the productive capacity of the plant, and the entire equipment is so constructed as to make it possible at comparatively little expense to add from time to time such additional units as will be necessary to enable this company to manufacture all the soda ash and allied products which Canada will require.

The construction of the plant furnished steady employment for an extended period of time to over one thousand men, and there are now employed regularly in the operation of the plant approximately four hundred men. Living conditions are good, and the advent of the plant has brought a new era of prosperity to Amherstburg and the surrounding country.

The Canadian Government has been quick to recog-

nize the importance of this plant and operation, since it is working along the lines which are universally accepted as the solution of most of the problems confronting the Dominion. For instance, it is furnishing Canada with a reliable and constant supply of an essential raw material for civil and military industrial needs. It is also creating wealth for the Dominion by the most feasible road open, viz., the development of previously little exploited natural resources, and is do-

ing a large bit to remedy any employment condition by furnishing employment and livelihood to a large number of Canadian workmen, and bringing material prosperity to the town, the province and the Dominion.

Sir Edmund Walker is president of the company; E. N. Trump, vice-president and consulting engineer; A. H. Green, vice-president and managing director; Wallace Campbell, vice-president, secretary and cashier. G. N. Comly is manager of the plant.

A Retrospect and Forecast of Chemical Merchandizing

By Philip S. Tilden

Heavy Chemicals Sales Manager of the E. I. du Pont de Nemours & Co.

At the Luncheon of the Philadelphia Chemical Club

THE Chemical Club of Philadelphia, composed of manufacturers and jobbers of chemicals in the Philadelphia territory, at its luncheon on Oct. 25, effected permanent organization by the election of the following officers: President, Sylvan H. Hirsch, of the National Chemical Products Co.; secretary, Hans R. Geyer, of the Jordan Import Co., Inc.; treasurer, William Thorn, of Innis, Speiden & Co.

On this occasion Philip S. Tilden, director of sales, acid and heavy chemical division, E. I. duPont de Nemours & Co., after complimenting the club on its birth and auspicious future, laid down the doctrine of his organization, that the chemical field is ample for the display of enterprise by everybody in it, without thought or desire to domineer or dominate. Mr. Tilden said:

Retrospection

"To provide a concrete example of expansion in the chemical industry I have brought with me a copy of the original prospectus of the General Chemical Co. discussed at a meeting in 1898, at which I was present and at which our good friend, Dr. W. H. Nichols, presided. This was one of the first business consolidations in an era fruitful in industrial combinations. The name of the company doesn't appear thereon, as it was not then selected and was left for later consideration. The organization of this company put a new phase on the chemical business. Before that time the companies were conducting business as individuals and trade solicitation was a more or less listless matter. True, there was competition, but it was not characterized by the intensive solicitation so prominent in later business history. The organization of this company and the application of its sound business principles by some competitors revolutionized the chemical business, which has enjoyed a steady growth from that time till now.

Expansion Illustrated

At that time a firm of Wall Street bankers issued a statement urging investment in the company, citing that the aggregate gross earnings of the proposed constituents was approximately \$1,200,000. When we compare their figures with the gross earnings of the General Chemical Co. for 1919, a rather poor year in the chemical business, which approximated \$6,000,000, we have a reflection of the expansion of the chemical industry in our time.

We all know how absolutely essential to the winning of the war were the contributions of the American chemical industry. It should be a source of great satisfaction to all who played a part in the feverish activity of production of that time that American enterprise in chemical manufacture responded effectively to every demand.

Present Conditions

At the present time our industry shares the slackness prevailing in all lines, but that should not deter those engaged in the chemical business from using every ounce of effort to procure every bit of business that is abroad at this time, whether from domestic or foreign markets. As regards political outlook, we must emphasize Mr. Harding's conviction that what we need is "less government in business and more business in government."

The Future

As to the future of the chemical business, I only can say, "God knows." If I knew I would go off and play golf and come back and reap the benefits at the proper time; but there should be no cause for pessimism. You cannot take care of 111,000,000 people which make up the United States without an expansion in the chemical business. We do not often realize that everything we have on or eat, and much that shelters us has been treated in some way by chemicals. Without chemicals we could not exist. Therefore we must forget the temporary dullness and work for the future. This is no time for contraction. I do not mean that we should needlessly expand, but we should be ready for what we know is in store for us in the line of increased demands for the articles which we represent. We are today suffering largely from our own sins, riotous living and extravagant purchases. We are now crying against those who administered the business of the Government for riotous and extravagant purchases. I believe, in a measure, they should be condemned, but we must realize that they also were only a part of the system which has been in existence since about 1915. We have gone beyond the bounds of propriety and it is no wonder that in many cases we were called profiteers. I think perhaps less of that was seen in the chemical market than in other lines of industry. The good old 'Ladies of Thread-needle Street,' such as the bichromates, prussiates and cyanides, have, however, given us many a sleepless night since the war began, and we must now bring ourselves to realize that we must again come down to earth and continue in the chemical business along the lines in which it is ordinarily conducted. If the buyers realize that we are again on a permanent basis, it appears to me that buying would be resumed in this business as well as in others.

Meanwhile the DuPont Company, I feel, stands ready to co-operate and help in every way possible. We are in business for the common good, and we desire to take advantage of no one, and I voice its sentiment and views when I say that we wish you all success."

Manufacture of Concentrated Nitric Acid from Nitrous Vapors

By M. Kaltenbach

Introduction and Translation by Ismar Ginsberg,
Aetna Explosives Co.

THE standard method of making nitric acid is by the decomposition of Chile saltpeter (nitrate of soda) by means of sulphuric acid. This is accomplished in duriron retorts, each holding about 6,000 pounds of nitrate of soda and an equivalent quantity of H_2SO_4 . The retort is set in a brick furnace so that it may be heated suitably to the proper temperature to cause the nitric acid vapors to evolve and escape from the retort through an opening at the top.

These vapors are lead through a condenser which causes the HNO_3 to condense. The old type of condenser known as the Hart condenser consisted of silica-glass tubes, set in parallel in suitable headers. These

nitro-glycerine, nitro-cellulose, T.N.T., etc., a large quantity of spent acid is recovered and must be treated in order to obtain acid in condition to be re-used in the manufacture. The first step in the treatment of this acid is the denitration or the separation of the sulphuric from the nitric. Originally this was done in crude fashion whereby only a very weak nitric was recovered. A development during the war enabled the production of strong acid from the denitration of these spent acids by the use of sulphuric acid in proper proportions to the nitric and the regulation of the temperature in the denitrating tower at such a point that the nitric acid was distilled off, while the water-content remained with the sulphuric, and weak sulphuric acid was obtained at the bottom of the tower.

The synthesis of nitric acid by the oxidation of ammonia gives a weak acid which must be concentrated before it can be used. It is well known, as Mr. Kal-

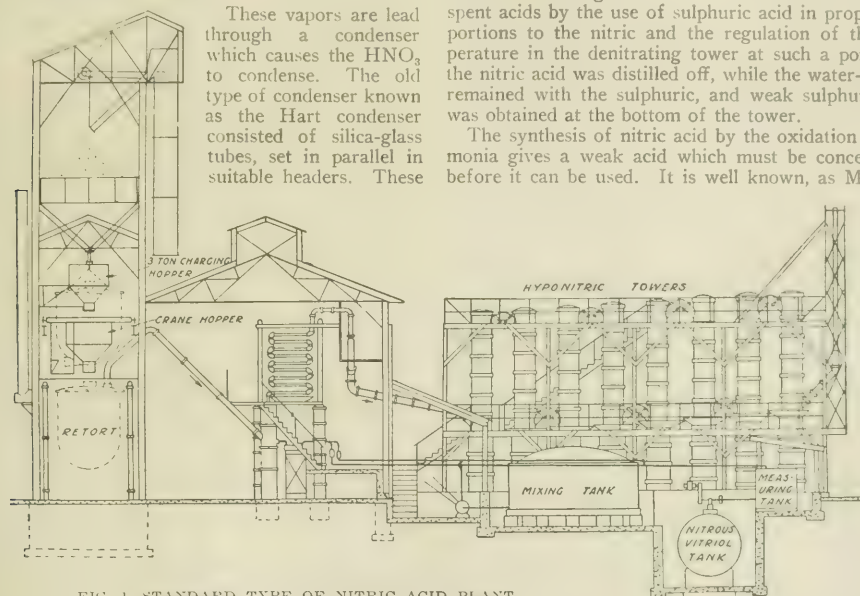


FIG. 1. STANDARD TYPE OF NITRIC ACID PLANT.

tubes were very disadvantageous in that they consistently broke, due to the unevenness of the temperature, and during the war they were replaced for the first time by "S" bend condensers made from duriron pipe.

The vapors which do not condense and which consist mainly of nitrogen peroxide, NO_2 , are led through a system of earthenware or duriron towers, known as hyponitric towers. In these towers the gases are oxidized and combined with water to form nitric acid. These towers are irrigated by means of pulsometer pumps with weak nitric acid in countercurrent to the flow of the gases.

The hyponitric towers are a very essential part of the nitric apparatus, as approximately 10 per cent. of the yield of nitric acid from the nitrate of soda is recovered in these towers. The oxidation of the nitrous oxides to higher oxides of nitrogen and the reaction of these oxides and water to give nitric acid is accomplished in these towers and can be controlled so as to obtain a maximum yield by the admission of air and by regulation of the steam jet draft at the last tower of the series.

In the manufacture of nitro compounds such as

tenbach describes in the following article, that pre-concentration by heat alone can take place only up to a nitric concentration of about 65 per cent., as beyond that point the acid and the vapor evolved therefrom have the same composition. Further concentration must be accomplished by the use of sulphuric acid which is mixed with the nitric to give a proper mixed acid, which when denitrated will yield strong nitric, as in the case of the spent acids described above. Mr. Kaltenbach describes a process in detail, wherein the hot gases from the ammonia oxidizers are used to effect this pre-concentration. A new mode of operating the denitration tower also is described, wherein the steam which is generally used to effect the denitration is replaced by nitric acid vapors. These nitric acid vapors are caused to meet hot sulphuric acid to which they give their water content. In this way there is considerable gain in fuel consumption, as not only is less fuel required for the operation of the tower itself, but a stronger denitrated sulphuric acid is obtained and consequently less water is required to be removed from it in the subsequent concentration operation.

The importance of the article lies in the presentation

of thermo-dynamic relations in the form of tables, whereby the exact importance of each step is recognized readily. The article as a whole constitutes a plea for more rational procedure in this most important process; that is, the concentration of nitric acid, the proper carrying out of which is essential to the success of not only the atmospheric synthetical production of the acid, but also of the economical operation of plants wherein nitration processes are used and spent acids recovered which must be reworked to insure the commercial success of the operation.

Catalytic Oxidation

In the oxidation of atmospheric nitrogen in the manufacture of synthetic nitric acid nitrogen peroxide, NO_2 , is formed directly at the temperature of the electric arc, or by the oxidation of ammonia in the presence of a catalyst. Nitrogen peroxide also is produced in the manufacture of nitric acid, and of the numerous nitro compounds, such as nitro-cellulose, picric acid, TNT, nitro-cuprine, nitroglycerine, etc.*

Fundamental Reactions

The fundamental reactions which govern the transformation of the nitrous vapors into nitric acid are as follows:

- (1) $\text{N} + \text{O} = \text{NO} - 21.6 \text{ calories}$
- (2) $\text{NO} + \text{O} = \text{NO}_2 + 19.9 \text{ calories}$
- (3) $\text{N} + \text{O}_2 = \text{NO}_2 - 1.7 \text{ calories}$
- (4) $2\text{NO}_2 = \text{N}_2\text{O}_4 + 12.8 \text{ calories}$
- (5) $\text{N}_2\text{O}_4 + \text{H}_2\text{O} = \text{HNO}_3 + \text{HNO}_2$
- (6) $3\text{HNO}_2 = \text{HNO}_3 + 2\text{NO} + \text{H}_2\text{O}$

Examination of these formulae shows that the NO_2 does not react directly to form HNO_3 , but must be polymerized first to N_2O_4 . This polymerization is governed by the laws of dissociation, i. e., for each temperature, an equilibrium exists between the reacting gases. The degree of dissociation also is dependent on the pressure and concentration of the gases, both of which factors favor the formation of the polymerized body, N_2O_4 . It therefore is advisable to operate at as low a temperature and as high a concentration and pressure as possible.

The curve A, Fig. 2, shows the variation in the proportion of N_2O_4 in the pure mixture with the atmospheric pressure for increasing temperatures. Formulae 5 and 6 indicate that only 2/3 of the N_2O_4 is oxidized to HNO_3 , the remainder reverting to NO , which is then reoxidized by the oxygen of the air. The cycle then is recommenced. As the reaction progresses the concentration of N_2O_4 diminishes.

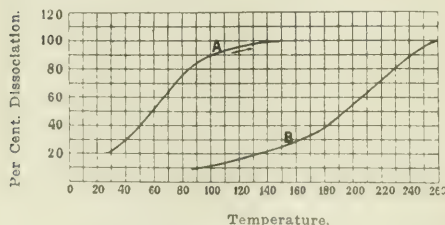


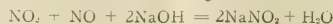
FIG. 2. DISSOCIATION CURVE.

Polymerization then becomes more and more difficult. At this point, another reaction, due to the action of NO on NO_2 takes place, viz.,



N_2O_3 may be converted into HNO_3 by oxidation in air, but at the degree of dilution existing ordinarily at

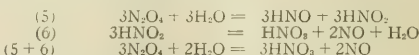
this point, the reaction necessarily is slow, it is better to fix the residual gases by means of an alkaline wash. The reaction which then takes place is



The nitrite is mixed with nitrate produced by the neutralization of the nitric vapors carried along mechanically with the other gases. In an acid reaction the nitrite is converted into the nitrate.

The principal reactions, 2, 4, 5 and 6, are facilitated by a reduction in temperature. It is therefore desirable to determine the effect of the heat evolved, which heat should be eliminated at the time and place of its formation.

The heat evolved in reactions 1 to 3 is indicated above; that produced in 5 and 6 may be found as follows:



Using the total heats of formation, we have

$$\begin{aligned} 3 \times 9.4 \text{ cal.} + 2 \times 68.3 \text{ cal.} &= (4 \times 48.8 \text{ cal.} - 2 \times 21.6) = Q \\ Q \text{ for 3 molecules } \text{N}_2\text{O}_4 &= 12.8 \text{ cal.} \\ Q \text{ for 1 molecule } \text{N}_2\text{O}_4 &= 4.266 \text{ cal.} \end{aligned}$$

In the following table (Table I) the heat of reaction have been calculated on the supposition that one and the same molecule of NO_2 goes through the cycle of reactions 2, 4, 5 and 6, four times in succession. It is unnecessary to add that these figures do not represent the phenomena with entire accuracy. They give, however, an idea of the maximum amount of heat evolved, which it is desirable to know in calculating the dimensions of concentration apparatus.

According to Ostwald, the catalytic reaction is,



which corresponds to a weight of combined oxygen of 112/34, that is, to a weight of air of $112/34 \times 100/23.2 = 14.2$ times the weight of NH_3 used. In practice, it is well to use 21.3 times the weight of NH_3 or 12,005 cu. m. of air (16.015 kg.) for one cu. m. of NH_3 (0.76 kg.). From reaction 7

17 kg. of NH_3 give theoretically 63 kg. HNO_3 ;
270 kg. of NH_3 (355 cu. m.) give 1,000 kg. HNO_3 ,

and require for that, practically, 5,750 kg. of air or 4,430 cu. m.

STUDY OF A REGENERATIVE PROCESS CAPABLE OF PRODUCING 10 TONS OF HNO_3 PER 24 HOURS

In this study, to be on the safe side, an 80 per cent. yield is assumed. It will be necessary to catalyze each 24 hours

$\frac{1}{0.8} \times 10 \text{ tons (270 kg. } \text{NH}_3 + 5,750 \text{ kg. air)} = 3,575 \text{ NH}_3 + 71,900 \text{ kg. air} = 75,75 \text{ kg. of the mixture, or in volume } 4,437 \text{ cu. m.} + 55.4 \text{ cu. m. air} = 59,837 \text{ cu. m. of the mixture, which corresponds per hour to } 140 \text{ kg.} + 2.3 \text{ cu. m. air} = 3,140 \text{ kg. of the mixture; or } 185 \text{ cu. m.} + 2.3 \text{ cu. m. air} = 2,485 \text{ cu. m. of the mixture.}$

The weight of water, contained in the mixture on the supposition that this enters the apparatus at 15°C. , and in a 50 per cent. air mixture will be about 5 grams per kilo.; that is,

$$5 \times 75,275 = 376 \text{ kg. or } 15.7 \text{ kg. per hour.}$$

The catalyst transforms the gas NH_3 into NO_2 and H_2O . The temperature at which this takes place is about 800 to 900°C. , but the heat exchangers, which are included in the installation, lower it to 300 to 350°C. Reaction 7 shows that the 140 kg. NH_3 treated per hour would furnish 222 kg. of water vapor and 380 kg. of NO_2 , using for that 461 kg. of oxygen which correspond to 1,987 kg. of air, leaving a residue of 1,526 kg. N.

*Chimie et Industrie, 1920, 578-590.

Table 1. Heat Evolved and Products Obtained in the Formation of One Molecule NO₂

Reaction	No. of Mols.	H ₂ O Prod. heat		Oxygen Necessary		Air per kg.	Calories Evolved		H ₂ O Necessary	
		Per Mol. H ₂ O	per kg. H ₂ O	per mol. O ₂	per kg. O ₂		Per Mol. NO ₂	Per Kg. NO ₂	Per Mol. NO ₂	Per Kg. NO ₂
Cycle I	1	46	46	10	10	12	6,400 (2,133)	8,533	185.5	6
Cycle II	2	15.33	15.33	3.33	3.33	14	2,111	9,511	206.8	2
Cycle III	3	5.11	5.11	1.11	1.11	177	711	3,171	69	0.006
Cycle IV	4	1.70	1.70	0.37	0.37	552	233	1,087	23	0.22
Total	5-6	46	46	10	10	7,703	22,275	481.3	8.88	192.8
Total Theory	46	46	46	10	10	7,703	22,275	481.3	8.88	192.8

Reaction 7 takes place with a contraction from 5½ volumes to 5 volumes for: 2 vols. NH₃ + 3½ vols. O (= 5½ volumes) give only 2 vols. NO₂ + 3 vols. H₂O (= 5 vols.). There is lost, therefore, ¼ of the volume (in cu. m.) for each cubic meter of NH₃ used. In the case in question, the contraction is 185/4 = 46 cu. m. on a total volume of 2,485 cu. m. per hour. The volume of gas coming out of the apparatus after catalysis is then (reduced to 0° C and 760 mm.): 2,485 - 46 = 2,439 cu. m.

The following table summarizes the operations:

Table of Weights and Volumes of the Gases (per hour).	
Before Catalysis.	
NH ₃ = 185 cu. m.	140 kg.
After Catalysis.	
Water vapor 222 kg.	NO: 380 kg.
Air 2,300 } Oxygen 483 cu. m. 590 kg.	O. (690-461) 229 kg.
cu. m. } Nitrogen 1,817 cu. m. 2,280 kg.	Nitrogen 2,280 kg.
	3,110 kg.
	3,110 kg. = 2,439 cu. m.
Density = 1.25 at 0° C, 760 mm.	Density = 1.275 at 0° C, 760 mm.

Elimination of Calories

The refrigeration process is divided into three stages: (1) from 350° C. to 100° C.; (2) from 100° C. to 30° C., and (3) from 30° C., wherein the reaction is isothermal.

(1) Between 350° C and 100° C, it is evident that the heat, generated by the polymerization of the NO₂, has no appreciable action. In fact at 100° C, the polymerization still is only 10 per cent.; the reaction of N₂O₄ and water cannot as yet take place. The heat which must be eliminated comes then exclusively from the heat in the gases themselves. The following table shows the distribution of the heat per 100 degrees decrease in temperature.

Refrigeration Between 350 and 100° C.
per 100 degrees decrease in temperature per hour.

Gas.	Specific heat.	Deg.	Wt. of the gas.	Calories.
Nitrogen	0.2438	100	2,280	55,500
Oxygen	0.2175	100	229	4,980
NO ₂	0.20	100	380	7,600
H ₂ O	0.48	100	222	10,650

Total for 100° C. 78,730
Total for 250° C. 196,825

(2) From 100° C. on, new phenomena occur. In the first place, the polymerization of the NO₂ is accelerated and reaches 87 per cent. at 38° C (Fig. 1). In the second place, the gases reach the condensation temperature which can be evaluated approximately, assuming that the tension of the water vapor is the same in the reacting gases as in air. This probably is not very far from the truth.

We have seen that the content in H₂O was 222 kg. + 15.7 kg. of original moisture, or 237.7 kg. for a weight of gas of 380 + 229 + 2,280 = 2,889 kg., i. e., 82.6 grams per kg. With that water content the condensation temperature is 49° C.; at 30° C. saturation

corresponds to a content of 25 grams per kg. The quantity of water condensed between the two temperatures is then 82.6 - 28 = 54.6 grams per kg., or 0.0546 kg. × 2,889 = 158 kg. The heat evolved in the condensation will then be 158 kg. × 620 = 100,000 calories in round numbers.

The quantity of water liberated in this manner is insufficient to assure the formation of the 46 per cent. nitric acid obtained as a result of this operation. Reactions 5 and 6 cannot, therefore, have their full effect and only will be completed when the gases are in actual contact with the irrigating liquids in the regenerative apparatus.

The total amount of heat evolved in the course of the reactions 4, 5 and 6, constituting this regenerative process, has been determined previously (see Table 1). It is difficult to determine exactly what proportion of this heat is evolved before the mingling of the gases with the irrigating liquors. In any event, this could only be a relatively small proportion.

If it is admitted that only the first cycle is completed, which is plausible, due to the insufficiency of the water present (see Table 1), the heat of reaction would amount to about 1/5 of the total calculated heat or about 160 calories per kilo of NO₂, which corresponds to 160 × 380 = 60,000 calories per hour.

To sum up, the following quantities of heat must be eliminated between 100° C. and 30° C.

Condensation of water vapor.....	100,000 calories
Cooling of gases (70 per cent.) about.....	55,000 calories
Start of the reaction.....	60,000 calories

Total 215,000 calories

(3) Starting from 30° C. and granting that the reaction proceeds isothermally, which is possible with proper manipulation, the heat of reaction that remains to be eliminated will be, according to Table No. 1, 483 - 160 = 323 calories. For 380 kg. of NO₂ it will be 323 × 380 = 123,000 calories.

Finally, therefore, we will have:

First phase : from 350 to 100° C.....	184,000 calories
Second phase : from 100 to 30° C.....	215,000 calories
Third phase : from 30° C.....	123,000 calories

Total 522,000 calories

The first part of the operation simply is the cooling of the hot gases. This is accomplished in practice in apparatus of large surface area, such as a battery of pipes, made of aluminum or some other resistant metal. These pipes are cooled with flowing water. It is, however, better to gain calories than to lose them, and we will see in due course what is the most rational use of this heat.

The second part is accomplished in earthenware coolers; the third in regenerative apparatus, consisting of towers filled with refractory packing.

According to the figures established above, the heat that must be eliminated is almost equal in each of the three stages of the operation. It is not quite so large

in the third stage as in the other two, but as the transmission of heat becomes more difficult as the difference between the interior and exterior temperatures diminishes, it is evident that the elimination of the calories in the third phase of the operation is appreciably more difficult and requires much more surface than in the first two stages. This difficulty is still further increased by the fact that in the towers the external air is the cooling agent, while in the first two stages water can be used. It therefore would be advantageous to cause the greatest part of the reaction to take place in the second stage. The thermal calculations, which have been developed above, show that to accomplish this, all that is necessary would be to add the requisite quantity of water to the nitrous gases and to dissipate the heat as it was evolved in suitable apparatus.

Required Quantity of Water

We have seen that each kilogram of NO_2 requires 0.193 kg. of H_2O for its transformation into HNO_3 (see Table 1); or for 10 tons HNO_3 ; $0.193 \times 46/63 \times 10,000 = 1,410$ kg. H_2O . But as the concentration of HNO_3 produced does not exceed in practice 46 per cent. the 10 tons of HNO_3 will be contained in $21,740 \frac{10,000 \times 100}{46}$ kg. of solution (—), of which 11,740 kg. are water.

The total water required, therefore, will be $11,740 + 1,410 = 13,150$ kg., from which, to be exact, it will be necessary to subtract the 160 kg. condensed in the gas coolers, leaving 13,000 kg. in round numbers. This, then, is the quantity of water (540 kg. per hour) that it is necessary to add to produce 10 tons of 46 per cent. nitric acid.

Intermediate Reoxidation of the Gases

Reaction 6 has shown us that the action of N_2O , on H_2O must be followed by a reoxidation of the NO (Reaction 2); then by a further polymerization (Reaction 4). This reoxidation will take place more slowly as the gases become more dilute. It is this fact which justifies the arrangement in which there are interposed between the absorption towers irrigated with liquids, chambers in which the gases circulate slowly and have time to oxidize, and then to polymerize.

The advantages of introducing additional air (oxygen alone would be preferable) are the increase in the oxygen concentration and the reduction in the temperature of the reacting gases. A disadvantage is the corresponding dilution of the NO_2 . In spite of this, practical experience has proven the advisability of this procedure, provided the gases are well mixed and the quantity of air permitted to enter the system are controlled carefully. Too much air is harmful. To allow the air entrapped in the acid lifts to enter the towers is poor practice, as it is very difficult, if not altogether impossible, to control it and always results in the admission of too much air.

When no air is introduced the final concentration of oxygen in the gases is found as follows:

Oxygen remaining after catalysis (Table I).....	229 kg.
Oxygen required for the oxidation according to reaction (2) — 167 grams per kg. NO_2 (0.167×380) (Table I).....	63.5 kg.
Total	165.5 kg.

The percentage oxygen in the mixture (2,280 kgs. nitrogen + 165.5 kgs oxygen) is 6.76 per cent. ($165.5/2,455.5$).

When 200 kgs. of air are added each hour this percentage is increased to

$$\frac{165.5 + 0.232 \times 200}{2455.5 + 0.768 \times 200} = \frac{211.9}{2590} = 8.16\%$$

Series of Towers

The recovery of the last traces of nitric and nitrous vapors is accomplished in towers filled with packing and irrigated with an alkaline wash. The elimination of heat is unimportant and the temperature of the solution in the towers need not be reduced. There are generally two towers in series, the first of which is irrigated with the liquors recovered in the second. In the second tower the liquors are alkaline, while in the first they are slightly acid. Under these conditions nitrate only (sodium nitrate) is recovered, instead of a mixture of sodium nitrate and nitrite.

Using the theoretical principles developed above, we are now ready to apply them to actual practice. Figure 3 is a diagram of the apparatus.

Simultaneous Cooling of Gases and Pre-concentration of Nitric Acid

Instead of cooling the gases and allowing the heat to go to waste it is better practice to use the heat in the pre-concentration of the weak nitric acid itself. This process has been patented recently. It is well known that it is impossible to concentrate nitric acid above 68 per cent. by a simple heating process, as at that point the composition of the liquid and the vapor is identical. This concentration corresponds to a constant boiling point of 123°C .

The heat in the gases from the catalysts is sufficient to pre-concentrate the acid. We have seen above that 10 tons of H_2SO_4 , the equivalent of 21,740 kg. of 46 per cent. acid, when concentrated to 60 per cent., is reduced to 16,666 kg. (10/0.6). Consequently the weight of water evaporated is 5,000 kg. in round numbers, or 210 kg. per hour.

The evaporation of a kilogram of water from weak nitric acid (from 46 per cent. to 60 per cent.) consumes about 900 calories, after taking into account all the radiation losses, the restoration of the heat of dilution to the nitric acid and the heat of vaporization of the weak nitric acid carried along. Hence, 189,000 calories (900×210) will be required each hour from the hot gases to effect the pre-concentration. It has been shown previously that the available heat than can be used for this purpose is 78,730 calories per 100 degrees decrease in temperature. At the tower outlet the temperature should be such that the water vapor cannot recondense.

These gases contain initially 237.7 kg. of H_2O (water of reaction and original humidity), to which are added 210 kg. of water in the weak nitric acid, which makes 155 grams of water in one kilogram of the gases ($\text{NO}_2 + \text{O} + \text{N}$). The temperature of the gases leaving the tower may be assumed to be 80°C ., whence the temperature at the entrance will have to be 320°C . ($240^\circ + 80^\circ$). As 18,900 cal. per hour is the required heat (see above), and as 78,730 cal. per hour are lost in cooling through a range of 100 degrees, the temperature drop is 240°C . ($\frac{189,000}{78,730}$)

The temperature of the gases leaving the catalyzers is 320°C . While efforts are made to eliminate as much as possible the heat of reaction in the catalytic process, the temperature of the gases from the catalyzers

can be raised to this point readily by the use of apparatus with larger reacting surfaces, suitable heat insulation, etc. In the Norwegian process the heat liberated is much greater than in the other catalytic processes and the conditions are therefore much more favorable to carrying out the pre-concentration of nitric acid as described above.

Pre-concentration Tower; Nitric "Glover Tower"

The operation of the tower is very similar to that of the Glover tower in sulphuric acid manufacture by the chamber process. The tower is made of siliceous stone, acid-proof metal, or earthenware. The proportions of tower, the ratios between gases and liquids, the temperatures and the pressures are all analogous to those in the Glover tower.

Economy of the Pre-concentration Tower

The advantages of this process are: (1) lower initial cost of the installation, compared with the expensive

coiled-pipe condensers, as seen at F and G in Figure 3. The cooling water flows over these pipe-coils. It is noticed that at F the gases travel upward, while in G they flow downward. Most of the condensation takes place in F and the vapors which escape from F are condensed finally in G. The temperature is lowered to about 30°C.

Oxidation and polymerization of the gases commence at this point. The liquid recovered is strongly acid. It is returned directly to the system by circulating it through the hyponitric towers.

The Regeneration Process

The gases first pass through an oxidation tower (see I, Figure 3), wherein the temperature is maintained at the optimum point for oxidation by means of the large cubical capacity of the tower; then through absorbers cooled externally (see J, Figure 3), in which the gases come in contact with the liquids flowing in counter cur-

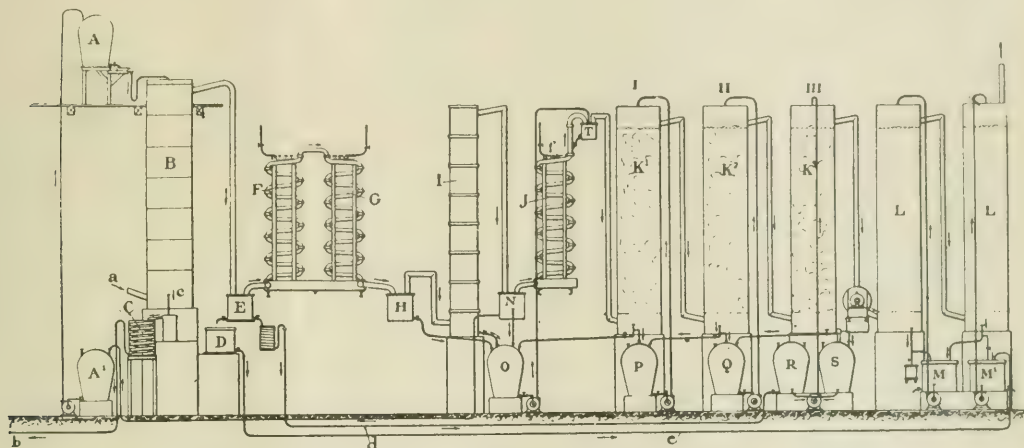


FIGURE 3. REGENERATION OF NITROUS VAPORS WITH PRECONCENTRATION.

A. Nitric acid 45%. B. Preconcentration tower. C. Cooler. D. Crock for Alkaline wash. E. Hot water, slightly acid with HNO_3 . F. Condenser coils for water vapor. G. Condenser coils for weak acid. H. Weak nitric acid. I. Oxidation tower. J. Absorption Coils. K. (1, 2, 3) Regeneration or Hyponitric towers. L. L. Towers irrigated with alkaline wash. M. M. Cocks for alkaline wash. N. Nitric acid, 45%. O. P. Q. T. Nitric acid. R. S. Weak nitric acid. a. Nitrous Gases coming from the catalytic oxidations of ammonia. b. Pipe leading to Storage Tanks of Nitric Acid to be concentrated. c. Nitric acid, 62%. d. Hot water slightly acid with nitric acid. e. Alkaline wash. f. Water.

aluminum coolers and other costly apparatus of the old pre-concentration process; (2) lower cost of fuel, labor, power and cooling water.

Cooling of the Gases

In the tower there is really no elimination of heat, but rather a transformation of the heat of the gases into latent heat of vaporization of water. Hence the coolers must eliminate the same quantity of heat as if pre-concentration did not exist. Only the temperature changes.

In contradistinction to the operation of lead chambers, it is not advisable in this case to allow the steam to enter the cooling apparatus. The steam is condensed and the hot water, containing but a trace of acid, is used in part to dissolve the alkaline reagent used to irrigate the last towers in the system; the rest is used as an irrigant in the last hyponitric tower. This plan of operation is justified by the fact that it is necessary to maintain a comparatively low temperature in the system, especially at the place where the nitric acid is most concentrated, in order to facilitate the polymerization of NO_2 and its reaction with water.

Condensation of the Steam

This is accomplished best in quartz or earthenware

rent; and, finally, through ordinary packed hyponitric towers (K in Figure 3), the last two of which are irrigated with an alkaline wash (L in Figure 3).

The most concentrated acid is drawn off at the base of the absorber and is fed to the pre-concentration tower to be brought to a strength of 60 per cent. approximately.

Dehydration of the Pre-concentrated Acid

The acid obtained from the pre-concentration operation must be concentrated to about 90 per cent. This is accomplished in a de-nitration tower in the usual manner. To supply the requisite heat steam is used, which results in production of weak sulphuric acid.

If the de-nitration operation could be carried out without the addition of steam a considerable saving in sulphuric acid and an important increase in the production of the tower for a given weight of acid charged would result. This is practicable and a new development in the concentration of nitric acid has been patented recently by the writer, based on the substitution of the vapor of nitric acid itself for steam. This process is quite analogous to the manufacture of ether by the Ergot process and the sulphonation of benzene by the Guyot process.

TABLE II.—THERMAL BALANCE OF A CONCENTRATION TOWER (PER 1,000 KG. HNO₃ PRODUCED). STEAM AS THE HEATING AGENT.

	1	2	3	4
	Steam Superheated to 400° C. and Sulphuric Acid at 20° C.	Steam Superheated to 400° C. and Sulphuric Acid at 90° C.	Steam Superheated to 400° C. and Sulphuric Acid at 20° C.	Steam Superheated to 400° C. and Sulphuric Acid at 90° C.
	(Kg.)	(Kg.)	(Kg.)	(Kg.)
1. Steam heat weak nitric treated.	45°	45°	27°	62°
2. Weight of weak nitric entering pending to 1,000 kg. HNO ₃	2,222	2,222	1,612	1,612
3. Weight of water is required to obtain 88% nitric (1.167 kg.)	1,686	1,686	476	476
4. Weakened 92.75% sulphuric to be charged to the tower to obtain a concentrated (88% H ₂ SO ₄) acid	5,609	4,600	3,509	2,800
5. Total weight of weak nitric and 92.75% sulphuric acid charged.	7,822	6,822	5,112	4,412
6. Total water	1,086	1,086	476	476
7. To be Sulphuric acid....	408	333.5	254	203
8. removed by Steam	962	5.4	861	544
Grand total	2,456	2,013.5	1,534	1,233
9. Weight of 68% sulphuric acid recovered	7,650	6,280	4,780	3,820
10. Temperature of weak nitric....	20° C.	20° C.	20° C.	20° C.
11. Temperature of sulphuric....	20° C.	90° C.	20° C.	90° C.
Balance: (1) Heat entering:				
12. Heat in nitric acid (HNO ₃ only) (sph. = 0.445)	9,000	9,000	9,000	9,000
13. Heat in water contained in (sph. = 1.000)	24,400	24,400	12,240	12,240
14. Heat in H ₂ SO ₄ (sph. = 0.386)	34,800	129,000	21,800	78,500
15. Heat in water contained in sulphuric acid	8,100	30,000	5,080	18,300
16. Heat of dilution between 93 and 68%	382,000	314,000	238,000	191,000
17. Total calories—input	458,300	506,400	286,120	309,040
(2) Heat leaving:				
18. Heat of vaporization of nitric acid	119,000	119,000	119,000	119,000
19. Heat in nitric acid at 100° C.	44,500	44,500	44,500	44,500
20. Total heat of vaporization of the water content at 100° C.	86,500	86,500	86,500	86,500
21. Heat in sulphuric acid (H ₂ SO ₄) at 160° C.	278,000	229,000	174,500	139,500
22. Heat of dilution of nitric acid	102,500	102,500	77,500	77,500
23. Heat in water contained in 68% sulphuric	392,000	320,000	245,000	196,000
24. Total calories—output	1,022,500	901,500	747,000	665,000
25. Total calories—input	458,300	506,400	286,120	309,040
(3) Difference to be furnished.	564,200	395,100	466,880	353,960
26. Calories in the steam injected..	616,000	439,000	514,000	405,000
27. Difference—radiation and losses	51,800	43,900	53,120	49,040
28. Ratio of 92.75% sulphuric to steam	1.93-1.00	1.66-0.82	1.08-0.625	1.47-0.50
29. Ratio of 92.75% sulphuric to weak nitric	2.52-1.00	2.66-0.82	2.17-0.86	1.74-0.68
30. Ratio of 92.75% sulphuric to water eliminated from nitric....	5.15-1.00	4.23-0.82	7.35-1.425	5.88-1.145
31. Ratio of acids charged to 8.8% nitric	6.90-1.00	6.00-0.87	4.50-0.63	3.84-0.55
32. Ratio of steam to water removed	0.885-1.00	0.546-0.618	1.72-1.94	1.14-1.29
33. Production of a tower for an equal amount of sulphuric and nitric charged	1.00	1.15	1.53	1.77

(Note: The second ratio in columns 2, 3 and 4 are found by dividing the figure in column 1 into the corresponding value in 2, 3 and 4. For example: Item No. 32, in column 2, is 0.546-0.618, 0.546 is the steam-water ratio. 0.618 is 0.546 divided by 0.885 (from column 1.)

Instead of introducing the nitric acid as a liquid in the de-nitrating tower it is first heated in a suitable apparatus (see G, Figure 4, either directly or through a steam-jacket and partly vaporized). This vapor is injected into the sulphuric acid contained in the bottom of the tower, while the liquid flows down the tower from a different level (see Figure 4).

By varying the proportion of the nitric vapors to the liquid the quantity of heat introduced into the tower can be varied. Regulation is accomplished in the reheater, and control is maintained on one hand through the temperature of the concentrated nitric vapors which are distilled at the top of the tower, and on the other hand through the coefficient of de-nitration of the recovered sulphuric acid.

This process is applicable to nitric acid both pre-concentrated or treated directly. Thermal balances have been prepared for acids of various concentrations (see Table No. 3), so that the necessary data are available for the operation of the plant without the first step of pre-concentration.

Thermal Equilibrium

The heat, entering the system, comprises: the heat in

TABLE III.—THERMAL BALANCE OF A NITRIC ACID CONCENTRATING TOWER (PER 1,000 KG. HNO₃ PRODUCED). NITRIC VAPORS INJECTED IN TOWER.

	Kg.	Kg.	Kg.	Kg.
	45%	60%	62%	65%
	1,000	1,000	1,000	1,000
1. Weight of HNO ₃ treated.....	2,222	1,666	1,612	1,540
2. Weight of weak nitric acid....	1,136	1,136	1,136	1,136
3. Weight of weak 88% acid....	1,086	330	476	404
4. Weight of H ₂ O to be eliminated				
5. Weight of 92.75% sulphuric charged	2,975	1,450	1,905	1,107
6. Weight of water in acid	216	105	94.5	80.5
7. Weight of H ₂ SO ₄ (5-6)	2,759	1,345	1,210.5	1,026.5
8. Weight of water (total) to be eliminated (4 + 5)	1,302	635	570.5	484.5
9. Weight of 68% sulphuric received	4,061	1,980	1,781	1,611
Heat entering the system:	Cal.	Cal.	Cal.	Cal.
10. Heat in nitric acid (HNO ₃) at 30° C. (sph. = 0.445)	13,350	13,350	13,350	13,350
11. Heat in H ₂ O of nitric acid	36,660	19,880	18,360	16,200
12. Heat in H ₂ SO ₄ at 90° C. (sph. = 0.386)	83,000	40,000	36,600	31,000
13. Heat in H ₂ O of sulphuric acid	19,400	8,450	8,500	7,250
14. Heat of dilution	202,000	99,000	89,000	75,300
15. Total	354,410	181,380	165,810	143,100
Heat leaving the system:				
16. Heat in H ₂ SO ₄ at 160° C.	148,000	72,000	65,300	55,000
17. Heat in H ₂ O in sulphuric at 160° C.	208,000	101,500	92,000	77,300
18. Heat of vaporization of nitric acid	119,000	119,000	119,000	119,000
19. Heat of vaporization of water in nitric acid at 100° C.	86,500	86,500	86,500	86,500
20. Heat in nitric acid at 100° C.	44,500	44,500	44,500	44,500
21. Heat of dilution of nitric acid	102,500	84,000	80,500	79,000
22. Heat of radiation	50,000	50,000	50,000	50,000
23. Total	758,500	557,500	537,900	511,300
24. Calories—input	354,410	181,380	165,810	143,100
25. Heat to be furnished	404,090	376,120	372,090	368,200
26. Calories to be furnished for each kg. of weak nitric acid injected. Item 25 ÷ Item 2	182	226	230	238
27. Heat in same between 30° C. and vaporization temperature..	65	61	60	58
28. To be furnished by vaporization of nitric	117	165	170	180
29. Percentage HNO ₃ in weak nitric vapors	11%	28%	35%	60%
30. Heat of vaporization of weak nitric	1.0 cal	119 cal	390 cal.	286 cal.
31. Per kg. weak nitric. Proportion to be vaporized	0.233	0.394	0.435	0.63
32. Per kg. weak nitric. Proportion to be introduced as liquid	0.762	0.606	0.565	0.37
33. Ratio—88% sulphuric to 8.8% nitric	2.62	1.28	1.15	1.03
34. Ratio—92% sulphuric to weak nitric treated	1.34	0.87	0.81	0.72

the sulphuric acid preheated to 100°C. in a heat exchanger, recovering in this way the calories in the de-nitrated acid; the heat in the nitric acid heated to the boiling point; and, finally, the heat of dilution of sulphuric acid, which is liberated when the acid comes in contact with the water in the weak nitric acid.

The heat leaving the system comprises: the heat in the recovered sulphuric acid; the heat in the nitric acid distilled; its heat of vaporization; and the difference between the heats of dilution of nitric acid at the concentration when it enters and leaves the apparatus; and, finally, the losses by radiation.

The additional heat required is, in the case of the 60 per cent. acid, 376,120 calories, which must be supplied by the weak nitric acid, whose weight is 1,166 kgs, or 226 calories per kilogram. The 60 per cent. acid charged to the tower will emit vapors containing 28 per cent. HNO₃. Its heat of vaporization, therefore, will be about 419 calories. To furnish the required 226 calories the weak nitric acid must first be heated from 30°C. to its boiling point (121°C.), which will necessitate 61 calories. The remaining 165 calories (226-61) will be furnished by vaporizing the acid. (165)

corresponding to a vapor weight of 0.394 kg. (419)

for each kilogram of original acid. That means that 39.4 per cent. of the weight of the original nitric acid will enter the tower in the form of a vapor and 60.6 per cent. in the form of a liquid at the boiling point (121°C.).

TABLE IV.—COMPARISON BETWEEN OLD AND NEW PROCESS
(TABLES II AND III).

	45% Nitric			62% Nitric		
	Without Super-heating Sulphuric at 30° C.	With Super-heating Sulphuric at 90° C.	New Process	Without Super-heating Sulphuric at 30° C.	With Super-heating Sulphuric at 90° C.	New Process
	A	B	O	D	E	F
	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.
1. Weight of nitric acid (HNO ₃)	1,000	1,000	1,000	1,000	1,000	1,000
2. Weight of weak nitric solution	2,222	2,222	2,222	1,612	1,612	1,612
3. Weight of 38% nitric	1,136	1,136	1,136	1,136	1,136	1,136
4. Weight of 93% sulphuric required	5,600	4,600	2,975	8,500	2,800	1,300
5. Weight of 68% sulphuric recovered	7,650	6,280	4,060	4,780	3,820	1,780
6. Total calories entering	158,300	306,400	354,410	286,120	309,040	165,810
7. Total calories leaving	1,922,500	901,500	768,500	747,000	663,000	537,000
8. Calories carried by the steam	504,200	393,100	.....	460,880	353,960	.....
9. Calories carried by the nitric vapors	Kg.	Kg.	Kg.	Kg.	Kg.	Kg.
10. Weight of steam injected	962	574	0	801	544	.....
11. Coal for super-heating 1 kg. per 10 kg. steam at 400° C. ....	.....	60	.....	.....	55	.....
12. Steam at 5 kg. for the vaporization of nitric acid (450 cal. per kg.) .....	.....	.....	1,000	.....	.....	830
13. Coal for same purpose. Direct heating 4,000 cal. out of 7,000 per kg. utilized .....	.....	.....	100	.....	.....	75

The data in Table III should be compared with those in Table II, as is shown, for the more important items in Table IV. The economy of the new process is evident immediately. In sulphuric acid alone the saving amounts to 50 per cent. It also is seen that the proportion of the nitric acid vaporized, before being injected into the tower, increases as the concentration of the weak nitric being treated becomes greater, but does not reach 66 2/3 per cent., even in the least favorable case. Apparatus

The apparatus used in the operation of this process, where steam is replaced by nitric vapors, is identical with that used in the ordinary de-nitration process with the exception of the regular steam-distributing device, which is replaced by an apparatus for heating and partially vaporizing the nitric acid before its introduction into the de-nitrating column. For this purpose two different forms of apparatus can be used. One consists of a series of tubes, surrounded by a jacket through which steam at 5 to 6 kgs. pressure is circulated as in the Kestner apparatus. The other consists of a

number of pans arranged in a cascade system, heated directly with gas or fuel oil.

It is unnecessary to enter into a detailed discussion of the construction of the apparatus, the empirical details of design, etc., as the difficulties that arise are in no way different from those which are encountered in the construction and erection of the regular concentration apparatus. It is much more interesting to compare the operation of the two processes from the standpoint of economy.

Comparison of Net Costs

(1) Saving in Sulphuric Acid.

In the regular process of concentrating nitric acid in one stage from 45 to 88 per cent. there are used 5,600 kg. of 92.75 per cent. sulphuric acid for every ton of HNO₃ produced (steam, not superheated), and sulphuric acid, cold). When the steam is superheated to 400° C. and the sulphuric acid is preheated to 90° C. the sulphuric consumption under similar conditions is 4,600 kg. In the new process (preliminary pre-concentration and use of nitric acid vapors) the consumption is reduced to 2,975 kg., or, compared with the above, 53 per cent. and 65 per cent. reduction respectively. When pre-concentration is used in both processes 3,500 kg. of sulphuric acid are used in the steam process, compared with 1,305 in the nitric vapors process, when the steam is not superheated and the sulphuric acid is used cold, and 2,800 kg. when superheated steam and preheated sulphuric acid are used.

(2) Saving in Steam and Fuel.

When superheated steam and preheated sulphuric acid are used to concentrate 62 per cent. nitric acid, the comparison between the two processes in fuel consumption is as follows:

Steam Process: 544 kg. steam and 55 kg. of coal for superheat.

Nitric Vapors Process: 830 kg. steam for jacketed tube apparatus, or 75 kg. of coal for direct heated apparatus.

If one kilogram of coal will produce six kilograms of steam the consumption of fuel is slightly less in the old process.

Labor, Compressed Air and Power.

The cost of labor, compressed air and power is approximately the same in both processes

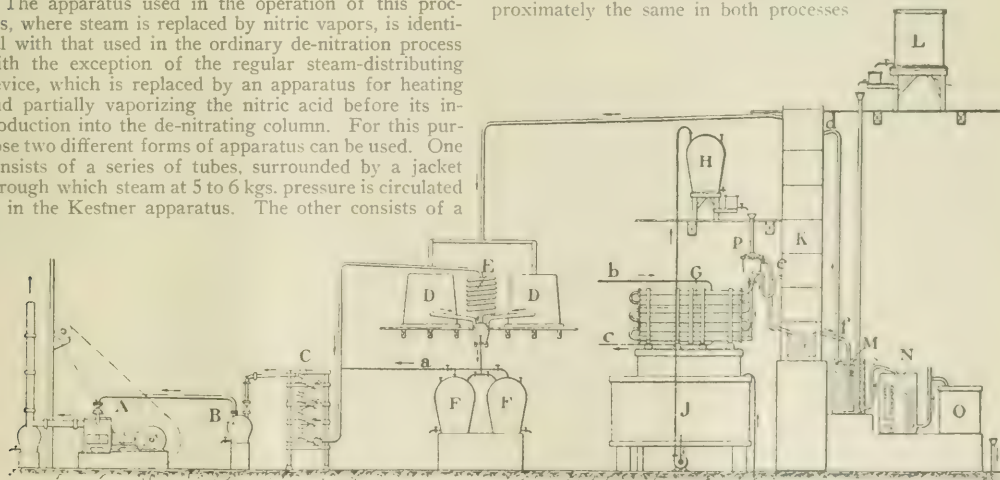


FIGURE 4. CONCENTRATION OF NITRIC ACID BY MEANS OF SULPHURIC ACID.

A. Vacuum pump. B. Safety tower. C. System of washers. D. Condenser. E. Nitric acid vaporizer. F. 92% Nitric acid. G. Nitric acid vaporizer. H. 62% Nitric acid. J. Nitric acid storage tank. K. Tower in Sulphuric acid. M. Heat exchanger. N. Cooler. O. Acid pots. P. Nitric vapors. a. Vacuum line. b. Steam. c. Water of condensation. d. Hot sulphuric acid. e. Hot nitric acid. f. Sulphuric acid.

Cost of Installation

The only difference in the cost of the apparatus between the two processes lies in the substitution of a nitric acid vaporizer for the steam superheater, while the additional cost of the vaporizer is not negligible, nevertheless it is more than counterbalanced by the reduced cost of the sulphuric reconcentrating apparatus (due to stronger and less acid being recovered in the new process) and the increased production of the denitrator. About 1,500 kilos less of H_2SO_4 are recovered per ton of HNO_3 treated by the new process than by the old, when pre-concentrated nitric is charged to the tower. In the case of the single stage dehydration of 45 per cent. nitric acid, about 4,000 kilos less of H_2SO_4 are recovered.

Connection Between the Pre-concentrating and De-nitrating Tower

A direct connection is desirable so as to avoid loss of heat. This is fraught, however, with many practical difficulties which it is not worth while to try to overcome. Consequently, the acid from the pre-concentra-

tion tower is run first by gravity into an intermediate tank which is heat-insulated. This tank serves to regulate the flow of acid to the denitrator. From there the acid goes to the vaporizer and thence to the tower, which is placed at the proper elevation to allow the installation of heat exchangers, coolers, receivers, etc., below. It is not good practice to use long piping systems, pumps, acid lifts and numerous tanks for conveying and containing hot nitric acid, as it attacks readily the metal of the apparatus. Hence, the vaporizer should be placed close to the tower and in such a position as to take advantage of gravity flow.

An old process installation can be converted into the new process without any difficulty.

By heating the nitro-sulphuric mixture before introducing it into the de-nitrating tower, similar advantages can be gained, as in the nitric vapor process. However, because of the greater extent of apparatus required, the difficulty of vaporization and the more corrosive action of the mixed acid on the metal of the apparatus, the nitric vapor process is much preferred.

Personal Items

Capt. Wilkinson Stark, late of the Ordnance Department, is now a member of the engineering staff of the John Johnson Co., filter press manufacturers, Brooklyn, N. Y. Capt. Stark is a former du Pont man whose experience in cotton bleaching and caustic recovery was utilized during the war in his supervision of the design and installation of the Army's cotton treatment and caustic recovery divisions at Nitro, W. Va.

* * *

Dr. William H. Walker, after twenty-five years of active service in teaching and research work in applied chemistry and chemical engineering, has tendered his resignation as director of the Division of Industrial Cooperation and Research of the Massachusetts Institute of Technology, to take effect January 1, 1921. Dr. Walker will be succeeded by Charles L. Norton, professor of industrial physics at the Institute and director of the Research Laboratory of Industrial Physics.

* * *

Albert C. Jacobs, president of the Keystone Glue Co., Williamsport, Pa., and King Upton, president of the American Glue Co., Boston, Mass., were elected respectively president and vice-president of the National Association of Glue and Gelatine Manufacturers, at the recent annual meeting of the association. Rufus W. Powell is a permanent fixture as secretary and treasurer at 81 Fulton St., New York.

* * *

Christopher G. Atwater, assistant to the vice-president of the Barrett Co., 17 Battery pl., New York, and manager of its agricultural department, has returned from a trip through the Orient of about seven months' duration, investigating markets for coke oven by-products.

* * *

Recent additions to the technical staff of the Eastman Kodak Co., Rochester, N. Y., embrace Walter R. Kirner, University of Illinois, in the department of synthetic chemistry; F. L. Richter, Cornell, in the research laboratory, and David Jones, John Hopkins, in the chemical division.

Wilson H. Law has resigned his position as head chemist, Cudahy Packing Co., Omaha, Neb., and with John H. Shaw, formerly associated with him in packing house work, will engage in consulting practice, with office and laboratory at Los Angeles, Cal.

* * *

J. D. Brown, formerly instructor in the Johnson City, Tenn., High School, is now in charge of the aniline department of the Union Dye & Chemical Corp. of that place.

* * *

William H. Clark, formerly sales manager of the Butterworth-Judson Company, has engaged independently in business in chemicals, dyes and oils at 224 Pearl street, N. Y.

* * *

A. J. Gailey, formerly with the W. L. Cummings Chemical Co., Lansdowne, Pa., is now research chemical engineer with the Electrometallurgical Co., Niagara Falls, N. Y.

* * *

J. R. Ruby, formerly engaged in rubber research at the New Jersey Zinc Co.'s research laboratory at Palmerton, Pa., is now associated with C. P. Hall, Akron, Ohio, dealer in rubber pigments and chemicals.

* * *

D. C. L. Sherck, Ph.D., 1920, University of Wisconsin, is research chemist with the Gillican-Chipley Co., Inc., naval stores producers, New Orleans, La., and 90 West St., New York.

* * *

Lewis C. Slater has resigned the assistant professorship of industrial and engineering chemistry at Louisiana State University to accept the position of chemist for the Bogalusa Paper Co., Inc., Bogalusa, La.

* * *

Lester Yoder has severed his connection with the Iowa State Experiment Station to become an assistant chemist in the research department of Parke, Davis & Co., Detroit, Mich.

* * *

Daniel H. Simpson, a physical chemist of the Bureau of Standards, has joined the sales staff of the Edison Electric Appliance Co., Inc., Chicago, Ill.

Industrial Notes

The Stauffer Chemical Co., San Francisco, Cal., has acquired a tide-water site at Seattle, Wash., for the construction of a sulphuric acid plant where later will be undertaken the manufacture of the heavy chemicals demanded in the Northwest. The company has plants at San Francisco, West Berkeley, Stege and Los Angeles, in California; Monongahela, Pennsylvania; Houston and Freeport, in Texas; Chauncey, New York, and Bordeaux, France.

* * *

The Zeller Lacquer Mfg. Co., capital \$250,000, is a New Jersey company incorporated by Hugo Zeller, 111 Broadway, and Gustave O. Zeller, 595 West End Ave., New York, and Richard Zeller, Jersey City, N. J. The Messrs. Zeller formerly were connected with the Egyptian Lacquer Co., 5 East 40th street, New York. Hugo Zeller was president, treasurer and general manager; Richard Zeller was vice-president, secretary and plant manager, and Gustav Zeller was assistant.

* * *

Wilson & Co., packers, Chicago, in acquiring a soap manufacturing department, does not intend to repeat the experience of Armour & Co. It will acquire the plant and business of the Globe Soap Co., of Cincinnati. Plans are being formed for the incorporation of a new corporation under the laws of Delaware, the stock of which is to be offered to stockholders of the Globe Soap Co. in exchange for their present holdings.

* * *

The United Fiber & Products Co., New Iberia, La., recently organized with a capital of \$1,000,000, is arranging for a stock issue of \$300,000, to be used for the purchase of machinery for its proposed new paper mills. It has acquired the plant of the Sugar Cane By-Products Co., devoted to paper and pulp production, and additions will be erected. William T. Larkin is president.

* * *

Amalgamated Sugar Co., Salt Lake City, Utah, has purchased the factory of the West Cache Sugar Co. in northern Utah for about \$1,000,000. Its slicing capacity is 650 to 700 tons of sugar beets a day. The plant is said to be one of the most modern now operating in the West.

* * *

The Carney Cement Co., Mankato, Minn., will construct a new plant near that city, to cost about \$150,000. The works, in addition to the main mill, will include machine shop, forge shop, and chemistry building. Richard K. Meade & Co., 11 East Fayette Street, Baltimore, Md., are the engineers.

* * *

The American Hard Rubber Co., 11 Mercer Street, New York, will erect a two-story addition to its College Point, L. I., plant, to cost about \$250,000 including equipment. Walter Kidde & Co., 140 Cedar Street, New York, are the engineers.

* * *

The Atlantic Enameling Corporation, New York, has been incorporated, with a capital of \$500,000, by D. W. Armstrong, Jr., N. Chasid, and J. Feldt, 220 West Forty-second Street, to manufacture enamelware products.

* * *

The Apache Powder Co., Benson, Ariz., a subsidiary of the Phelps, Dodge Corp., 99 John street, New York, has begun the construction of a plant for the manufacture of explosives. Approximately \$5,000,000 will be invested in the enterprise.

J. R. Geigy, S.A., of Basle, Switzerland, with American representation in the Greigy Co., Inc., 89 Barclay St., New York, has organized its English representative as the Geigy Color Co., Ltd., with a capital of £20,000.

* * *

The National Bituminous Enamel and Paint Corp., will build at Baltimore, Md., a plant for the manufacture of bituminous paints and enamels, comprising an 8-story, 150x150 ft., and a 3-story 75x50 ft. reinforced concrete building. J. R. Broderick is president.

* * *

Texas Chemical Co., Houston, Texas, will construct the second unit of its sulphuric acid plant at Manchester, Texas, which will have a daily output of 100 tons. It is intended to construct two additional units in the near future.

* * *

With the exception of the U. S. Mint, the Eastman Kodak Co., Rochester, N. Y., is the largest consumer of silver bullion in America. Its requirement of the metal for the production of silver nitrate is two tons per week.

* * *

Bennett & Davis, Inc., 327 S. La Salle St., Chicago, Ill., has remodeled its coumarin plant at Wauwatosa, Wis., permitting a production output of 4,000 lbs. per month.

* * *

Capitol City Products Co., margarine manufacturers, Columbus, Ohio, will build a two-story and basement oil refinery, 50 x 100 ft., to cost about \$100,000 with equipment.

* * *

Security Cement & Lime Co., Security, Md., will double the capacity of its 3000-barrel per day plant at that place. Similar plans are contemplated as regards its plant at Berkeley, W. Va.

* * *

Harry H. Picking, Chas. O. Geyer and Gordon Grand of East Orange, N. J., have incorporated the Leatherwear Co., capital \$250,000, for the manufacture of leather substitutes and rubber and paper compounds.

* * *

D. W. Stubblefield, of Belle, W. Va., has organized a \$1,000,000 corporation, which has acquired the government chlorine plant at that place, which it will use for caustic soda and chlorine products manufacture.

* * *

The Burdett Oxygen & Hydrogen Co., Chicago, manufacturer of industrial oxygen, etc., has increased its capital from \$210,000 to \$600,000.

* * *

Chewing gum consumption in Mexico is increasing to the degree of encouraging the Wm. Wrigley, Jr. Co., Chicago, Ill., to construct a plant in Mexico City.

* * *

The Fisheries Products Co., Wilmington, N. C., is planning the erection of a new fertilizer plant, to cost in excess of \$500,000, including the machinery.

* * *

The Glenmore Co., Lima, Ohio, operating a local oil refining and compounding plant, has acquired property at Buffalo, for the erection of a branch plant.

* * *

United Color & Pigment Co., Newark, N. J., has completed its new lithopone plant.

The Chemical Construction Co., Charlotte, N. C., is building a masonry Glover tower at the sulphuric acid plant of the Meridian Fertilizer Co., Meridian, Miss.

* * *

Old Hickory smokeless powder plant, 18 miles from Nashville, Tenn., built for the Government during the war by the DuPont Engineering Co., at a cost of \$85,000,000, has been acquired by the Nashville Industrial Corp., the highest bidder, for \$3,505,000. Individual sales and transfers of material and equipment to other government departments yielded \$5,890,000, making a total salvage of \$9,400,000, in addition to the reservation of storage space for smokeless powder, sodium nitrate, cotton linters, powder-making equipment and materials for a five year period, with a subsequent rental option. The purchaser plans to establish an industrial center, and has for sale a great amount of surplus chemical equipment.

A Factory Lantern

A common tool around a chemical plant is a lantern, an improved, durable and absolutely safe form of which



is shown in the illustration of the new La France No. 1810, made by the American-La France Fire Engine Co., Elmira, N. Y., for watchmen's use or in any place around the plant where an open flame cannot be exposed, or electrical connections are not available. The durable construction, wide and intense projection, focusing features and ease of control, make this lantern an indispensable piece of factory

equipment. The current is supplied by two standard dry cells, obtainable anywhere.

Temperature Indicator for Storage Piles

A device for indicating temperatures in masses of stored material liable to deterioration or destruction by rise of temperature or spontaneous combustion, e. g., coal stored in open piles or ship bunkers, is shown in the diagram of the Coalometer marketed by F. C. Thornley & Co., Inc., 31 W. 43d St., N. Y. City.



Diagram of Temperature Indicator.

Could the consumer look beneath the surface of his coal pile and definitely acquaint himself with conditions existing there, he could save himself enormous losses by using that part of his coal supply first which showed a tendency to become even slightly heated. In other words, he could burn the heat units which had started to escape before they had done so.

It is for the purpose of indicating these conditions beneath the surface that the Coalometer was designed. It consists of a set of temperature indicators encased in a long, pointed steel tube, carrying at varying depths metal bulbs (corresponding to the bulbs of thermometers), and at its upper end a set of indicating dials which show the exact temperatures of the bulbs which actuate them. These units are forced down into the coal pile to definite depths and at various points, and collectively furnish definite data to the consumer as to the exact temperature existing beneath the surface.



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CHEMICAL AGE

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LLOYD LAMBORN, *Editor*

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Utilization of the Patentable Discoveries of Government Technical Research for the Benefit of Industry

By Dr. Frederick G. Cottrell

Director, Bureau of Mines

THE culmination of the earnest thoughts of many minds both in and outside of the Government service, framed with the utmost conscientiousness and proposed by those who believe that scientific material of great potential value continually developed in government technical work is not made available to industry and hence to the public and so becomes a waste product, is the measure now seeking enactment which will provide a means of turning this waste product into a valuable public asset.

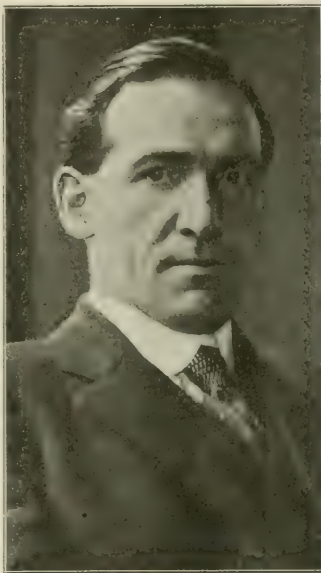
Without interference of present or future methods in the bureaus attempting to handle Government inventions and patents, it is the only feasible plan as yet proposed to put legally these discoveries into industrial use, by centralization of effort and with the maximum efficiency and a minimum of confusion, expense and failure.

Outright dedication to the public, while working well for many inventions just ready to fit, without further development, technical or economic, into industry, has proved futile, for reasons appearing later, where other patents are concerned.

Perfection is not claimed for this measure; its permissive and not mandatory character provides that elasticity of construction which will permit prompt correction of whatever shortcomings operation may develop.

Legislative History of the Bill

The bill, presented by the President to the House Committee on Patents, has been approved unanimously by the patent committees of two Congresses (65th and 66th, or present) and was passed by the Senate March 22, 1920. In the absence of opposition and to secure early enactment, it was added as an amendment to the Nolan Bill, H.R. 11984, providing for the relief of con-



DR. FREDERICK G. COTTRELL
Director, Bureau of Mines

ditions in the Patent Office, after the Nolan Bill had passed the House and was before the Senate Committee on Patents. It was then that opposition to this bill (forming a section of the Nolan Bill) developed. Efforts made to separate the measure from the patent office bill were opposed by Senator Norris and Representative Nolan, chairman, respectively of the Senate and House Committees, because of their belief in the great public importance of the bill and of the conviction that opposition to it arose either in misunderstanding or narrow self-interest. Accordingly the new measure emerged from committee as Section 9 of the Patent Office bill, and after much debate in the closing hours of the session passed the Senate on June 4, 1920.

The measure as thus passed by the Senate is an amended form of the original construction, resulting from the desire to provide safeguards against apprehended danger of the Government engaging in business in attempting to develop the patents assigned as provided for, and to exclude from the provisions of the bill inventors outside the Government service.

The Patent Office bill, itself radically amended as to the form in which it passed the House, has been referred to conferees, and it is now proposed to strike out in conference Section 9 of the bill. Should this be done, we have the following situation: The original measure has been referred unanimously to the House by the House Committee on Patents, and in the same form has passed the Senate. Proponents of the measure hope for success on the House floor during the coming session.

Section 9, Patent Office Bill.

The original measure, which appears as Section 9 of the Patent Office bill, amended for the reasons above stated, reads as follows:

"Sec. 9. That the Federal Trade Commission be, and hereby is, authorized and empowered to accept assignment of, on behalf of the United States, under such regulations and in such manner as the President shall prescribe, inventions, patents and patent rights which said commission deems it to the advantage of the public to be so accepted, as these may from time to time be tendered it by the employees of the various departments or other establishments of the Government, and to co-operate, as necessity may arise, with scientific or other agencies of the Government in the discharge of the duties herein set out, and the Federal Trade Commission is hereby authorized and empowered to license and collect fees and royalties for licensing said inventions, patents and patent rights in such amounts and in such manner as the President shall direct, and shall deposit the same with the Treasurer of the United States; and of the total amount of such fees and royalties so deposited a certain per centum, to be determined by the President, shall be reserved, set aside, and appropriated as a special fund to be disbursed as directed by the President to remunerate inventors for such of their inventions, patents and patent rights contemplated by this section as may prove meritorious and of public benefit: *Provided, That nothing herein shall be construed to give to said commission or any other governmental agency any authority to engage in the manufacture of any such invention or patented article.*

The Commissioner of Patents is hereby directed to grant all patents and record all assignments and licenses contemplated by this section without the payment of any fee."

Conditions Sought to Be Corrected

The basic considerations in view of which the measure was proposed, in brief are as follows:

1. There is no fixed or general policy dealing with inventions and patents developed by Government employees in the course, or as a result of, their official duties, and consequently no governmental administrative machinery for translating such inventions and patents into actual public service.
2. In cases where patents are developed by the combined efforts of Government employees and others, difficulties at present arise concerning the administration of same because of the conflict between the rights of the inventors and those of the United States.
3. There is no way at present by which patentees in or outside the Government service can dedicate their patents to the public with the assurance that the public will reap the full benefit therefrom, because an invention covered by a patent so dedicated does not interest capital, and because it may be excluded from public use by patents subsequently taken out by others.
4. Conditions brought about by the war, causing an unprecedented demand for inventions, and the industrial developments and readjustments now following the war, call imperatively for guidance. Also the host of inventions developed during the war in the many Government bureaus and other organizations, primarily for war purposes, but which have a peace application of inestimable value, should be co-ordinated, conserved, and translated into industrial use.

Accordingly there is provided by this measure a means aimed to be acceptable to the medical profession of patenting and consequently properly controlling inventions in the field of medicine and surgery, the control of patents by private interests being contrary to the ethics of the medical profession.

It is desirable to have governmental administration of a certain type of patents, not ordinarily attractive to manufacturers, in order to provide production of needed devices or materials for governmental or public purposes.

The President, under the authority of Congress, has set a precedent for the proposed legislation by authorizing and directing the Federal Trade Commission to administer enemy-owned patents.

The patent administration here contemplated provides for revenue sufficient to cover the expenses of its operation. Provision is made for some remunera-

tion to patentees, to reward special merit, and to stimulate invention.

Opposition

Since the close of the last session of Congress this measure has been the subject of pronounced criticism, the bulk of which unfortunately has been destructive rather than constructive in character.

At a meeting in New York, Oct. 15, 1920, under the auspices of the American Institute of Chemical Engineers, the New York Sections of the American Chemical Society and the American Electro-chemical Society, and the American Section of the Society of Chemical Industry, discussion of the measure served to sift the objections into such form as to permit their ready consideration.

Consideration of Criticism

- I. Creation of fiction and antagonism between Government and private industry.

The administration here contemplated is for the benefit of all industry, to be helpful to it and, while inviting its full co-operation, to avoid carefully cause for friction and antagonisms.

- II. Committing Government to participation in private business on a selective competitive basis through licensing power by the Federal Trade Commission. It is doubtful if this can be done without showing partiality, even with wise administration, in view of the necessity of affording protection to licensees.

This measure does not commit the Government to participation in business except in the capacity of a trustee operating for the benefit of industry, between industry and the Government's scientific bureaus, conveying to business something that business can make profitable use of. It provides a plan for doing this to the best advantage, having, however, the public welfare primarily in view. Therefore, a certain amount of discretion will have to be shown with regard to licensing, but the aim will be to get the process or device used as freely and widely as possible, just enough restriction in licensing being practiced to ensure maximum development and profit to licensees consistent with wide application and use in the interest of the people.

The method of handling the monopoly as here suggested is recognized as comparable with that in vogue for public franchises and with the banking laws of some of the states. For instance, only as many street car lines in a city are granted charters as there is a real demonstrated need for, and in Massachusetts, Wisconsin and some other states, the laws provide for just enough banking facilities to insure proper and adequate administration, without unduly increasing the number of banks for the business to be done, thus establishing a safeguard against the carrying of too much overhead, which is a bad business policy, liable to lead to disaster involving the public.

After all, in a general way, national welfare, the hope of civilization itself, depends primarily upon the safeguarding and advancement of the public interest, and industry in the pursuit of its own ends cannot afford to ignore this fact. Public service is bound to pay large dividends in prosperity, and prosperity is the handmaiden of business.

- III. Success of the plan depends on its manner of administration. There is no certainty that this will be wise and in accordance with the good intentions of its promoters.

It is admitted freely that the success of this measure rests on the way it is administered. So does the success

of most things. In a way, the same constitutional safeguards would surround it as surround other forms of Government activity. Its operation would be open and subject to instant criticism both from outside and within the Government service. Failure to function with success would mean self-elimination. No further patents would be offered for assignment, this being a purely permissive measure. This fact will operate as a corrective; a stimulus to careful, conscientious management.

IV. Power once acquired by Government is not relinquished easily, and is likely to extend far beyond the original design.

In general it may be said that governmental maladministration is bound, sooner or later, to be censured and corrected by the public. Ultimate relief for bad management, encroachment on business and undue extension of powers would be found in the first instance in an appeal to executive authority, and beyond this, if necessary, to corrective or eliminative legislation.

V. Under this proposed administration the President has authority to order all patents evolved in the Government service assigned, and that the Government could thus become a holding company on a large scale, owning patents which may affect seriously all branches of industry.

The construction of the machinery by which this administration shall move is left in the discretion of the President, not that he is going to have the time or the information to carry out personally the execution of the matter, but that the greatest amount of flexibility shall be secured for the action of those to whom will be intrusted the formation and control of the organization necessary to put it into effective operation. In this, the original intent and further counsel of those who framed the measure will naturally be given due weight and they already have clearly provided, as a fundamental consideration in the bill that it should be merely permissive, its experimental character being fully recognized. It is exceedingly unlikely, therefore, and not seriously to be considered, that the President would, in the face of this, order all Government patents to be administered through this agency. If it proves on trial to be a helpful thing to the public and industry there would be no reason for making it mandatory.

There seems to be no reason why the Government should not, for the public benefit, act as a holding company for its patents just as it has been acting in connection with its co-operative developments and reclamation projects.

VI. There are so few Government patents of value that this legislation is not necessary.

The argument advanced that this measure is unnecessary, anyway, because so few Government patents are deemed of value, does not possess the virtue of consistency, being out of harmony with the other objections raised, and particularly with the one just considered.

VII. Another way of making the inventions effective is by dedicating them to the public and promulgating such industrial regulations as will call for the patented article or process.

The same lack of consistency is found in the suggestion that patents may be dedicated to the public and that this dedication may, in some way, be made practicable by promulgation of industrial regulations, what-

ever these may be. This would seem to imply Government interference in private business in a very drastic form.

VIII. The effect on the Government employe will be to influence him to pursue lines of work leading to personal gain to the neglect of fundamental research in the interest of the public, and that the Government technical man thus will become commercialized.

The assumption that this measure will develop commercialism in the Government employe and lure him, for the sake of private gain, away from his proper work on technical problems in the interest of the whole public, shows a more cynical estimate of this type of man than is believed justifiable, and a misunderstanding of the control under which he works and of the sort of reward here contemplated. The man pursuing science primarily for the money that may be derived from it does not stay in Government service and so passes out of consideration here.

The average technical man of the Government service is one whose main interest is centered in his work; in the attainment of scientific results for their own sake. That is why he is and remains in the service in spite of the meagre remuneration, and particularly under the extremely unfavorably salary conditions now obtaining. That is why the Government always has been able to attract and hold men of the highest scientific attainments, successfully competing for them with the far more lucrative field outside; and it is this type that makes the ideal employe. For such men monetary gain is of secondary interest, the main thing is the opportunity to carry on their work with the assurance of a salary sufficient to support themselves and their families in comfort and to educate their children.

The attractive feature of this bill to them will be the opportunity it offers of having inventions which they may develop translated into successful, public application. Furthermore, it must not be presumed that Government technical work is conducted so aimlessly that men engaged in it would be permitted to go off on a tangent at will in pursuit of special lines for their own profit. And finally, the remunerative feature of this bill is a consideration of minor importance compared to its main object. In no case are the awards apt to be large.

As it was conceived by the framers of the bill, the spirit manifested in making these awards should be much the same as that underlying the gift of the Nobel prize. It is felt they would best be conferred by some competent authority other than that administering the patents themselves, such, for instance, as the National Academy of Sciences, or the Smithsonian Institution. The ideal basis of award should be real accomplishment for the public good rather than return in dollars and cents. The remuneration fund should accumulate as a pool, whereby the return from individual invention would be completely merged in the whole, in this way furnishing a safeguard against any sordid consideration.

IX. This measure will discriminate, through the rewards contemplated, against the non-technical employes of the service, and will have a harmful effect on service organization. It is declared that such rewards would not be granted in private business for this reason.

It is becoming more and more the custom in industry to reward technical workers for profitable inventions evolved in the course of their duties. These rewards take the form of promotions, of gifts of stock,

or money bonuses. The rewards are granted both as a recognition of merit and as an incentive to further effort, and no element disturbing to organization has, it is believed, been introduced thereby, as it is recognized that such rewards are appropriate, because it requires long years of study and the outlay of much money to fit a technical man for his duties, whereas this is not ordinarily the case with the clerical man.

Furthermore, the latter's work is generally of a routine type, susceptible of proper appraisal and recompense, whereas the creative genius of the research worker defies exact classification and the full value of his contributions to human progress is impossible to estimate in advance. It is this peculiar form of merit that the awards here under discussion are designed to recognize. There is no reason, however, why any employee in the Government service who advances through creative genius the public interest should not be a beneficiary of such reward as is here contemplated.

Compliance with Medical Ethics

One feature of this bill as originally introduced has received the acknowledgment of a spokesman for the medical profession. Through an editorial appearing in the *Journal of the American Medical Association*, Dec. 20, 1919, it is welcomed as means of handling and controlling patents which it may be desired to take out on medicines and surgical appliances. There is at present no dignified way comporting with the ethics of the medical profession of doing this.

Publicity

As it has been intimated in several quarters that the passage of this measure was being sought without sufficient publicity, thereby preventing opportunity for any opposition to develop, or to have voice in the proceedings, attention is called to the fact that in addition to the editorial appearing in the *Journal of the American Medical Association*, above cited, the bill was featured in the *Journal of the Patent Office Society* for November, 1919, pages 154-6; the *United States Bulletin* described the bill and commented on it in its issue of March 29, 1920, page 293; a paper discussing one phase of the bill in detail was printed in the *Scientific American* for April 10, 1920, under the heading, "Creating an Asset," page 394; another paper treating the bill from a different angle appeared in *Science* under the title, "Inventions and Patents," April 30, 1920, page 421, and the *Oil, Paint and Drug Reporter*, on May 17, 1920, printed a criticism of the bill under the title "Patent Bill Objected To" page 39.

The measure was brought to the attention of the representative of the A. S. M. E., on the Patent Committee of the National Research Council, and also on the Patent Committee of the United Engineering Society, in a letter dated January 16, 1919, and to the attention of the Secretary of the Engineering Foundation of New York, in a letter dated March 31, 1920. The President of the Patent Bar Association was present at the hearings had on the bill before the House Committee on Patents.

Stream Pollution and Industrial Water Purification

By J. T. Travers

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STREAM pollution as it exists in Ohio at present is a problem more serious than the average individual comprehends. Domestic pollution, known as city sewage, where it is not mixed with industrial waste is not considered by us to be deadly to fish life, although where it is allowed to flow into a slow-moving stream untreated and in excess of what nature can take care of by self-purification it often becomes a nuisance and a menace to public health. However, means of taking care of domestic sewage are well developed in this state.

Many streams throughout the state are so grossly polluted by manufacturing industry, caused by the chemicals used, that not only all kinds of fish life, but also the small organisms that fish feed upon are destroyed. The chemical makes water dangerous to bathe in; and for agricultural purposes it is worthless, as farmers could not expect their stock to thrive by drinking water that is so charged with poison that it kills fish and all manner of vegetation. Pollution is so far-reaching in its effects that farmers are often imposed upon where polluted streams run through their farms, causing a depreciation of land values because of the lack of pure water. It is unreasonable to believe that any industry should be permitted to destroy the value of fertile land.

I have developed a process to treat and render harmless to fish life all kinds of industrial waste now discharged into our streams with the harmful results above noted. The process is new and just out of the experimental stage. At the present time we are just finishing a large tank at the Houstain Creamery at South Charleston, Ohio. It is intended to take care of 100,000 gallons daily of creamery waste, consisting of buttermilk

and milk-can rinsings. We had occasion recently to clean out a large sedimentation vat at this plant which had several years' accumulated sludge in the bottom. To test our incomplete equipment I ran the supernatant liquid, which, when discharged untreated, caused the sewage to become inky black and foul-smelling, to the extent of 100,000 gallons through the system and fed the clay by hand, the automatic feeding apparatus not having been set up yet. The results exceeded our expectations, as the effluent was as clear as spring water and without odor. These results with creamery waste can be obtained with all kinds of organic pollution.

The base we use is marl clay free from grit and found in various parts of the country. I find that when this marl is combined properly and fed into the discharge as it issues from the factory, along with any of the well-known agents for coagulation, a rapid precipitation of all organic matter is effected. The precipitation tank must be so constructed that the separated matter can be removed without disturbing continuous operation. The process perfected by this department will take care of the following forms of pollution:

Organic Pollution.—Strawboard works, canneries, leather works, slaughter houses, packing plants, creameries, cheese factories, casein factories, tankage plants and domestic sewage.

Acid Pollution.—Residue from steel mills, copperas water from coal mines and all waste liquor from plants where acids are used. The process neutralizes the acid before it enters the stream.

The Bureau will furnish the details of the process to any manufacturer who wishes to use it.

Status of the Brewing Industry in the United States

By George Defren

Vice-President, Avery Chemical Co., Boston, Mass.

BEEER, including ales, porter and stouts, has been defined as a beverage made by the alcoholic fermentation of a hopped infusion of potable water and malted cereals with or without the addition of any malted or prepared cereals or sugars. The Volstead Act prohibits the use of the word "beer" or "ale," although the cereal beverages, so-called, marketed today by the breweries are nothing but beer minus some alcohol. It is simply a rose by another name.

The brewing industry has been undergoing violent reorganization since the Eighteenth Amendment to the Constitution went into effect January 16, 1920. Not only has there been a terrific wiping out of invested capital, but labor has also been considerably affected.

In the Old Days

The Federal Census of 1914 showed that there were 1,250 brewing concerns in this country with a capitalization of \$792,914,000. It has been estimated that at least \$500,000,000 additional were invested in equipment to transport and real estate to market the brewery products. In other words, approximately \$1,300,000,000 were involved in the fermentation beverage industry directly or indirectly.

This does not take into consideration the capital invested in the distilled beverage business.

The breweries produced in 1914 beers to the value of \$442,140,000; 75,404 persons were actively engaged in the business. From the capital invested, we find that the brewing industry ranked sixth in importance in the United States.

In 1914, 66,189,473 barrels of thirty-one gallons each of beer were sold.

The Transition

During the fiscal year ending July 1, 1919, the brewers of this country paid into the Treasury of the United States the sum of \$124,264,703.65 in the form of a stamp tax on their product.

This stamp tax has been shown to be the easiest, simplest and cheapest impost to collect in this country.

From a production of about 66,000,000 barrels in 1914, there was a gradual decline to about 60,000,000 barrels in 1917, at which time the United States entered the World War. Regulations then began to be placed on the production of fermented beverages, so that in 1918 only about 50,000,000 barrels of beer were sold.

The President, by authority of Congress, reduced the quantity of materials entering into the production of beers to 70 per cent. of their former amount. This was followed by a further presidential proclamation limiting the amount of alcohol to $2\frac{3}{4}$ per cent., and this figure was the one in vogue at the time the Prohibition Law went into effect.

The official figures for the fiscal year ending June 30, 1919, showed a decline in production to about 27,000,000 barrels. The figures for 1920 are not yet available. It is, however, a safe assumption that the production for the calendar year of 1920 will be approximately 10,000,000 barrels of a beverage containing less than one-half of one per cent. of alcohol by volume.

Near-Beer Revenue

So-called cereal beverages are now taxed at 15 per cent. of their selling value. This means that the brewers

of the country are contributing approximately ten to twelve millions of dollars to the National Treasury this year in taxes in contra-distinction to the \$124,000,000 for the fiscal year 1919, to say nothing of the immense aggregate revenue yielded by state excise laws. Not only has there been a great falling off in the revenues obtained by the state and federal governments, but it has cost the Treasury Department a very much greater amount to collect the present small tax.

Under the New Dispensation

While no figures are available, it is generally conceded that practically two-thirds of the breweries of this country have gone out of business since January, while others are closing daily.

Defunct breweries are generally dismantled. Some are converted into cold storage plants at small expense, but their field is limited. Others are used for ordinary storage where four walls and floor space are the main requirements. Others have been converted into machine shops, glyceride-oil refineries, candy, shoe, malted syrup, ice cream or soft drink factories, etc.

The interior equipment has been sold almost entirely at a tremendous sacrifice, largely to brewing concerns in foreign countries.

Most of the breweries which are operating today are doing so at only a small percentage of their former output.

Brewers as a whole are recognizing their unfortunate former alliance with the saloon, especially their connection with the distilled beverage trade. Many of them are putting out their cereal beverages only in the form of bottled goods, they having discontinued entirely their draft beers, which were drawn from the wood.

While the saloon still exists, it is operating mainly as a blind to dispense, "on the quiet," distilled liquors or "moonshine." No saloon which relies solely on the sale of cereal beverages can live.

Technical Adaptation

Over a year ago, when it was decided that prohibition was to come into effect, brewers began active experiments to produce a beverage which would meet the requirements of the new law. Their activities developed into two lines, viz., the manufacture of their products, first, by the so-called "checked fermentation," and second, by the so-called "de-alcoholization" processes.

Brewers operating under de-alcoholization processes are now legally classified as "distillers."

"Checked fermentation" means that the brewer makes his mash in the usual manner as heretofore, but checks the fermentation before the alcoholic percentage has reached the legal limit of one-half of one per cent. by volume. In this process large quantities of glucose, often sold under fanciful names, are used in place of malt. Checked fermentation is accomplished by quickly lowering the temperature of the liquor to near the freezing point, at which stage the yeast becomes inactive and fermentation ceases.

Fermentation may also be checked by heating the liquor to 140° Fah. for about one-half hour. This pasteurizes it. In other words, the yeast is killed and no more alcohol is produced.

Checked fermentation beverages are treated frequently with preservatives to guarantee the results desired

by preventing active fermentation, which would increase the percentage of alcohol.

If any malt is used in the checked fermentation type of beers these generally have a worthy taste. It has been found that refined edible lactic acid added to near beers improves appreciably the flavor and taste, thereby making them much more palatable.

The "de-alcoholization" process is based upon the removal of the alcohol generally by evaporation from a beer of former standards ranging from three to approximately six per cent. alcohol. Among these may be mentioned "open kettle de-alcoholization," which means simply boiling off the alcohol at atmospheric pressure until less than one-half of one per cent. remains. The entire alcohol evaporated in this process is lost, and clearly is an economic waste. Another de-alcoholization process is carried out in the usual high-column rectifying still, often under vacuum, whereby the alcohol is recovered. A third method consists in removing the alcohol from the beer in the form of a thin film in a rapidly rotating cylinder, also under vacuum, at a temperature of 140° Fah., at the same time recovering all the alcohol as a by-product.

As a barrel of beer containing four per cent. alcohol yields about one gallon of 195-proof alcohol, it is naturally advantageous to recover this, especially if the daily output be large.

All of the beers made by the de-alcoholization processes are necessarily cooled to near the freezing point and are impregnated with carbonic acid gas to give them the requisite "life." It has been found that lactic acid is of great assistance in giving de-alcoholized beverages a more acceptable taste than is the case without such an addition. The increased acidity has a tendency to fill the void arising from the absent alcohol.

The Cereal Beverage Business

The cereal beverages during the past season have not been uniformly successful. Consumers of beer in former days were accustomed to a beverage which had been brewed with an initial gravity of twelve to fourteen per cent. of solids in solution. On fermentation, this gave a beer containing three to four per cent. alcohol and approximately four to six per cent. of extract.

When the Volstead Act went into effect, all beer in the United States had less than 234 per cent. of alcohol by weight and about three to four per cent. extract. Many brewers had large quantities of this on hand. In other words, these beers contained approximately seven per cent. of extract, plus alcohol, in solution. When this beer was de-alcoholized the four per cent. extract only remained, in comparison with the pre-war standard of about nine to ten per cent. combined alcohol and extract. Consumers were asked to accept this beverage, containing only four per cent. of material in solution. This beverage generally had an unsatisfactory cooked taste at that. Being faced with great losses, the brewers charged wartime prices for an inferior article. The outcome naturally was dissatisfaction. Diminished consumption followed.

Some brewers are raising the gravity of their beers so that the most successful today are showing a gravity of approximately seven to eight per cent. of solids in solution and their trade is now increasing. This is a logical development when it is considered that practically all ginger ales and other so-called soft drinks on the market contain from eight to twelve per cent. of solids in solution. Beverages containing only four per cent. of solids are practically unsalable. This matter of color, foam and a hop taste like that of normal, old-time beer is not enough to continue its former sales.

Extensive advertising is assisting the sales materially.

Dissatisfaction of the Old Soaks and the Revival of a Household Art

Beer consumers have become so dissatisfied with the present beverage available that extensive home-brew operations are in vogue all over the country. These home-brews are made from malt and hops direct, or from an extract of malt in the form of a syrup, diluted with water, boiled with hops or hop extracts and fermented by the ordinary yeast cake obtainable at every grocery store. These home-brews develop anywhere from one to six per cent. of alcohol, depending on the concentration of the materials employed. In other words, instead of having beers made scientifically, under hygienic conditions, on a large scale, as was the case until prohibition came into effect, the manufacture of beer is now being done as in colonial days, when practically every farmhouse made its own ale.

From the reported sales of hops as a basis, it is calculated that more home-brew is being made today than is sold by the entire brewing industry with their new cereal beverages. Whether this situation is going to redound to the welfare of the country is anybody's guess.

Swiss Progress in Celluloid Manufacture

The World War bereft Germany of her European monopoly of raw celluloid manufacture. For a period of 20 years before the war the German celluloid manufacturers carried on a very flourishing trade and distributed large dividends. A certain amount of raw material produced in Germany was imported into Switzerland and used for the manufacture of toilet and other articles by various small Swiss factories.

The most important of these concerns decided to manufacture celluloid on its own account, and suitable accommodation for the new plant was found in the Swiss Explosive Works at Worblaufen. These premises were hired from the Swiss Government, and work was begun in 1919. The success of the undertaking was immediate, and shows no sign of diminishing in the near future. The German manufacturers are unable to compete owing to the shortage of raw cotton and of camphor, and for many years to come will probably not be in a position to do any damage to the newly-born Swiss industry.

The installations at Worblaufen are very complete and are not confined to the production of raw celluloid. All kinds of celluloid goods are manufactured from start to finish.

During the last few months a plant for the manufacture of synthetic camphor from turpentine has been erected at Worblaufen. This artificial product is appreciably cheaper than natural camphor, and there is apparently no drawback to its use. It is expected that as a result of the use of synthetic camphor the price of celluloid will decrease. There is already a considerable export trade of Swiss celluloid, and the supply is not yet equal to the demand.

The Tubize Artificial Silk Co., American representatives Mercken Bros., 487 Broadway, New York, announces that at its artificial silk plant at Hopewell, Va., its manufacturing activities will be confined to the production of very fine threads (between 35 and 120) required by weavers of narrow fabrics (ribbons), the underwear trade and the mills producing broad and fancy silks.

Problems of the Oil Shale Industry

By Russell D. George

State Geologist and Professor of Geology, University of Colorado

THE obtaining of oils from shales is a chemical process, and chemical reactions depend upon physical conditions. The physical conditions are imposed by the apparatus we use and the way in which we handle that apparatus. If our apparatus or our handling of it imposes physical conditions out of harmony with the results desired it is useless to look for success.

The secret lies in knowing what reactions must take place to produce the desired results, and in shaping the apparatus and operating it to secure those reactions.

The Blazed Trail of Scotch Experience

The writer has tested the Scotch oil shales and oil shales from England, South America, Canada, California, Nebraska, Colorado, Utah, Wyoming and other states. These shales differ in details, but the fundamental problems of treatment are the same—the problems of hydro-carbon chemistry. These problems have been solved in Scotland, France and Australia. The history of the Scotch shale oil industry is a story of scientific research by chemists and engineers of the highest rank. It is a story of evolution—the survival of the fittest in apparatus and in manipulation. The road is strewn with discarded apparatus—the best in its day. It is marked by abandoned theories and processes—each having played its part in reaching the goal.

Instead of profiting by the half century of experiment and experience of Europe, most of our experimenters have ignored all the progress made at the expense of ceaseless toil and millions of money and have chosen to be "pioneers," secretly cherishing the thought that chance, inspiration, revelation, or their own superior mentality will enable them to present to the world a process beside which the poor old Scotch process will recall the days of the stage coach.

They are presenting theories and "inventing" apparatus and processes abandoned twenty or thirty years ago. If they want to improve on the Scotch process, why not start from the best and advance? The exact form of the retort is not vital, but the physical conditions it imposes are vital. The form of the retort may be the best ever, but the operation of that retort may produce the worst results ever.

It is highly probable that modifications of the Scotch retorts and processes may be needed to meet peculiarities of our Colorado and Utah shales, but the broad needs are the same.

Comparison of Colorado-Utah and Scotch Shales

Our shales far exceed the Scotch shales in oil content, and consequently the tendency to coke and clog will be greater. This is not an insuperable difficulty. Our shales contain a smaller percentage of nitrogen available for ammonia. This fact may make certain modification of treatment desirable. But it is not fundamental. Our shales appear to contain more pyridines than do the Scotch. This will modify the refining process, and certain changes in the retorting may help us to avoid the difficulties they present.

Scientific Problems Awaiting Solution

Much has been said about extracting the oil in 20

minutes, 30 minutes and other short times. Possibly it can be done, but the getting of oil, or oil and fixed gas, is not the final goal. The ultimate purpose is the refined products. Will the 20-minute oil yield them?

The scientific problems to be faced by those who seek to establish a shale oil industry fall into two groups: (1) The problems of retorting, and (2) the problems of refining.

In this country, up to the present, attention and effort have been directed almost entirely to the solution of the problems of the first group. This is due to the natural, but erroneous, assumption that crude shale oil is like crude well petroleum and may be successfully refined by the same processes.

This assumption would be reasonably safe if oil shale were merely shale saturated with petroleum. True oil shales like those of Colorado and Scotland contain no ready-made oil, but are rich in the materials from which oil may be formed if the shales are properly treated.

Problems of Retorting

The problems of retorting are:

I. To convert as much as possible of the oil-making material of the shale into oil or other useful products.

II. To secure a crude oil containing the largest possible percentage of the most valuable constituents, such as gasoline, kerosene and lubricating oils, and the smallest possible percentage of worthless and harmful materials which must be removed as waste in refining.

III. To secure a crude oil which is easily fractionated into gasoline, kerosene, lubricating oils and others, and which yields fractions of cuts which are easily refined.

IV. To secure as large a yield of ammonia and other valuable by-products as possible without sacrificing more desirable results.

V. To reach the highest commercial efficiency without sacrificing the raw materials of the company or of the country.

The cost of equipment and operation of the refinery will depend very largely upon the efficiency of the retorting plant in meeting and solving these problems. It will be found that a little greater care in retorting will be rewarded by a great reduction in refining costs.

Retorting Problem I

The carbonaceous material of Colorado oil shales appears to occur in three forms: (1) true hydrocarbons in the solid form occupying extremely small pits and intergranular spaces in the shale; (2) plant and possibly animal matter which has undergone changes akin to those by which vegetable matter is converted into coal, and (3) fixed carbon. The relative proportions of these three materials are far from constant. In some rich shales the true hydrocarbons, probably paraffins, greatly exceed the other two materials. Such shales when examined under a powerful microscope show great numbers of grains of true hydrocarbons and very little, if any, vegetable tissue. The fixed carbon content of such shales is generally low. On the other hand, there are shales in which the vegetable tissue greatly exceeds the hydrocarbons in quantity.

In retorting the true hydrocarbons appear to vaporize at a comparatively low temperature, while a higher heat is necessary to develop hydrocarbon

gases from the vegetable matter, and the last hydrocarbon gases are given off at a very high temperature. Whether these last come from the true hydrocarbons or from the altered vegetable tissue it seems impossible to determine. The fixed carbon cannot be converted into hydrocarbon gases unless, in some way, the necessary hydrogen is supplied, and it is doubtful whether the hydrogen and carbon can be made to unite under the conditions prevailing in the retorts.

From the above facts it will be clear that the shales are not simple homogeneous materials yielding their gases by volatilization at a definite temperature or within a narrow range of heat.

Two questions arise: Is the gas which comes off at the highest temperature worth getting, or is it secured at too great cost of fuel and time? Are there any means of securing these last hydrocarbons at lower temperature?

To the first question the answer must depend upon the proportion of these high temperature hydrocarbons to the total yield, and their character and value. The proportion will be different in different shales. Their value is probably questionable, as the high temperature necessary is likely to make a large percentage of uncondensable gases valuable only for fuel.

The second question may, with reasonable certainty, be answered in the affirmative. The use of superheated steam in the retorts seems to reduce considerably the temperature required to drive them off, and it is probable that it will also reduce the proportion of uncondensable gases. To secure them for their fuel value would be penny wise and pound foolish, since equally good fuel can be obtained much less expensively.

The fixed carbon has a high fuel value, but unless air is admitted it cannot be directly utilized as fuel, and will remain in the spent shale.

Influence of Steam

When steam is used for retorting, the conditions in the retort resemble those which obtain in the manufacture of water gas, but the best temperature for the formation of the oil vapors is too low to convert the carbon into carbon monoxide. If, after the oil vapors are driven off, the shale is passed on to another section or chamber of the retort or to a secondary retort and there raised to a much higher temperature to get the maximum yield of ammonia, steam passing through this highly heated mass will not only aid in getting the ammonia, but will cause the formation of water gas by the union of the oxygen of the steam with the fixed carbon of the shale, and the freeing of the hydrogen. In this way the fuel value of the carbon may be saved, and the fuel value of the hydrogen added.

When superheated steam is used the desirable gases are given off at lower temperatures. Its value in the solution of other problems will be discussed later.

Retorting Problem II

Some well petroleum yields a large percentage of gasoline, kerosene and other light oils, others yield little or none of these light fractions. Some yield high-grade lubricating oils, others are worthless for this purpose. Some well petroleum yields so little of any refined product that they are valuable only for fuel. Others contain valuable constituents but yield them only at prohibitive cost, and so cannot be profitably refined.

Crude shale oils differ just as widely in their possibilities, but the differences are due to the methods of

manufacture, not to uncontrollable natural causes. Oils are composed chiefly of hydrocarbons, but there are many different forms of hydrocarbons. In the formation of common petroleum in the earth, the character of the original materials, the heat and pressure to which they are subjected, the presence or absence of water, the character of the rocks and mineral substances with which they come into contact, are all factors in determining what hydrocarbons will be formed, and consequently the character and value of the oil which will result. It is equally true that the conditions of retorting will determine the character and value of the shale oil produced.

What are the controllable conditions in retorting shales for the manufacture of oil?

Rate of Applying Heat

Time must be given for the heat to penetrate the shale, and for the gases to form and escape. Experience shows clearly that certain gases are formed at low temperatures, others at intermediate temperatures and others at high. Time is a factor in all chemical reactions. If the bases formed at low temperatures are the best for oil-making, the heat must be applied slowly to give time for it to penetrate the shale and for the gases to form. In lime burning this is a most important factor. Too rapid application of heat causes sintering of the stone and the closing of the pores by which the gases escape.

A similar condition results in the shales by the excessive formation of fixed carbon through the cracking of the hydrocarbons of the shale, and the cracking of the gases, both of which are wasteful, and result in excessive production of fixed or non-condensable gases and fixed carbon, and an oil low in gasoline. Objectionable compounds are formed which must be removed in refining, and some of them present the greatest difficulties encountered in refining, and greatly add to its cost.

The gases evolved at low temperatures are the best, the proportion of condensable gases is largest, the percentage of paraffin gases is highest, and that of impurities is lowest. The oil obtained is more easily refined, and the proportion of light oils is greatest.

Maximum Temperature

Retorting at too high temperature results in the formation of much fixed gas, a low content of gasoline and kerosene in the crude oil, inferior lubricating oil and a crude hard to refine. The Scotch call it "burnt oil." But the shales contain varying proportions of material which can be converted into hydrocarbon gases only at temperatures so high as to be very injurious to those gases formed at low temperatures. Similar heat is required to get the best yield of ammonia. In some shales the amount of carbonaceous material convertible only at high temperature is negligible, but in others it may reach 15 to 20 per cent. The problem suggests several possible solutions.

(1) Sacrificing the high temperature material and the high yield of ammonia. This would save fuel and time and increase the throughput, and might compensate for the loss of oil and ammonia.

(2) Doing the principal part of the retorting at a relatively low temperature and passing the shale on to another section of the retort, or to a finishing retort, where it may be subjected to the high temperature necessary for securing the last of the hydrocarbons and the higher yield of ammonia. This is largely practiced in Scotland, because the ammonia is relatively a more important product than it would be in America.

(3) Intermittent retorting—securing the main yield of condensable gases at low temperature and finishing the charge at high temperature. It is known that the high temperature gases contain a lower percentage of condensable gases than do the low temperature gases, and are of less value.

It should be stated that with the use of superheated steam in the retort the last hydrocarbons and the larger yield of ammonia are secured at lower temperature than by dry distillation. In fact it is impossible to secure the full possible yield of ammonia without the superheated steam.

Experiment and experience and markets will decide which of these solutions of the problem will be best.

Presence or Absence of Water in Retort

The beneficial effects of superheated steam in the retort appear to be:

(1) Evolution of gases at lower temperature, saving time and fuel.

(2) Twice or three times the yield of ammonia.

(3) A lower percentage of unsaturated hydrocarbons, possibly as a result of the protection afforded by the steam.

(4) A higher percentage of lighter oils in the crude.

(5) The prevention of coking and clogging.

(6) The more rapid removal of the oil vapors from the retort, preventing decomposition.

Under certain conditions the use of superheated steam is unsatisfactory. In test made on samples of Kimmeridge shales from England the superheated steam caused the formation of an obstinate emulsion which made fractionation and refining difficult and slow. This was also noticed in testing a California shale. Once or twice obstinate emulsions were formed in treating Colorado shales, but the manipulation was at fault.

As to the quantity of superheated steam required: The best results were obtained by the use of water at the rate of about 650 to 750 pounds per ton of shale.

Access of Air

It is argued that the admission of air will increase the yield of ammonia. This is more than doubtful, and it is highly probable that both the nitrogen and the oxygen of the air may form injurious combinations. Air certainly causes mechanical difficulties. Some operators in Scotland admit air at the bottom of the retort to aid in gasifying the fixed carbon. This is done when the temperature is run up to get the last of the ammonia.

The Time Shale is Held at Different Temperatures

The low temperature distillation requires much more time than does the finishing high temperature.

Pressure in the Retort

Experience in the cracking of oils suggests the desirability of retorting under pressure to prevent the cracking or decomposition of the paraffin hydrocarbons. But experiments in retorting under pressure have proved unsatisfactory. On the other hand, the longer the gases are allowed to remain in the hot atmosphere of the retort the greater the cracking and decomposition. A slight suction reducing the pressure about one pound below that of the atmosphere causes a quick removal of the gases formed and probably prevents much decomposition. The Scottish retorts are run under slightly reduced pressure.

Removal of Vapors from Retort

This should be as rapid as possible. Many attempts have been made to remove and keep separate the vapors formed at different temperatures and effect a selective condensation. But, while this is possible in small measure, it is doubtful whether it will be possible or profitable commercially. It is highly desirable to have numerous outlets for the gases so that they may escape from the retort without passing a long distance through the hot shale.

Added Materials as Catalysts or as Actual Chemical Reagents, etc.

Various materials have been mixed with the shales in the retort with a view to bringing about reactions and improving the products. Such materials belong to two classes:

Catalysts—substances which induce or condition reactions but which do not take part chemically.

Substances which enter into the chemical reactions.

Definite beneficial results have been obtained in laboratory work along this line, but considerations of cost of materials, bulk and handling appear likely to offset the advantages gained. To be commercially valuable and practical the materials must be cheap, readily available, effective in small amounts, and must produce positive results which tell in the quality of the finished products or in operation of the retorting and refining processes.

Perhaps one of the most desirable results to be aimed at would be the elimination of the very persistent coloring matter which characterizes shale gasoline and kerosene.

Size of the Material

The heat penetrates the shale very slowly. It is, therefore, desirable to crush it rather fine, so as to give large surfaces in proportion to the volume of the fragments. It should not be so fine as to pack and clog.

Heat Distribution

On account of the slowness with which heat penetrates the shale it is of the greatest importance that the body of shale should not be too thick. In certain forms of retorts stirring devices may be used to facilitate heat penetration of the mass and so prevent overheating or spot heating and the objectionable results which follow it.

Even the best crude shale oil contains a large percentage of unsaturated hydrocarbons called olefins. Until recently the refining methods used in the United States removed the olefins from kerosene and gasoline. This led to the erroneous notion that olefin hydrocarbons could not be used in motor fuel, and a number of writers have stated that shale oil could not be used for the production of gasoline.

If by "gasoline" is meant a motor fuel consisting mainly or wholly of paraffin or saturated hydrocarbons, their contention is correct, for the loss would be prohibitive. But if the term "gasoline" is made to include all fuels suitable for use in internal combustion engines similar to those used in automobiles, the contention is far from correct. The motor spirit put on the market by the Scottish shale oil companies contains from 60 to 70 per cent. of olefins and 30 to 40 per cent. of paraffins, and it gives highly satisfactory results.

In European countries large quantities of benzol are used as motor fuel. This is obtained by the distillation of coal, and consists of members of the benzene series

of hydrocarbons, and contains no paraffins. And yet it is a satisfactory motor fuel.

Some of the cracked gasolines on the market in this country contain as high as 25 per cent. of unsaturated hydrocarbons (olefins), and the users do not even know it.

The problem is not to secure from shales a "gasoline" or motor spirit composed of paraffin hydrocarbons, but to secure a motor spirit or motor fuel which will do the work regardless of its composition. Experiments have shown that the explosive energy of an olefin motor spirit is delivered more slowly, but through a longer period of time, than is that of a paraffin gasoline. They have also shown that the total energy delivered weight for weight is from 10 to 15 per cent. greater for the olefin motor spirit than for the paraffin gasoline, and that the mileage obtained is correspondingly higher. Olefin gasoline vaporizes at a lower temperature than does common gasoline of the same gravity. This is a distinct advantage in cold weather.

The gist of these facts is that shale oil "gasoline" will deliver 10 to 15 per cent. more energy, and will deliver it in a steadier, or less jerky fashion, causing less vibration and therefore less strain upon the motor and the machinery driven by it.

It is contended that the olefins deposit more carbon in the cylinders. This is a problem of carburation and has been solved.

Retorting Problem III

Some shale oils are hard to fractionate, hard to refine and yield but little of value. Some are so spoiled in the making as to be unrefinable and worthless except for fuel. Colorado shale oil yields 16%-22% natural gasoline and 40%-45% kerosene. The crude oil should be easily fractionated and the fractions should be easily refined.

The best results in this direction are obtained by low temperature retorting with superheated steam. High temperatures and dry distillation tend to unnecessary reduction of the light oil content, the formation of crudes from which but little gasoline can be obtained without cracking, and the production of obstinate sulphur compounds and nitrogen-containing compounds which render refining difficult and costly and reduce the grade of the products obtained. It also reduces the yield of condensable gases and increases that of the fixed gases.

The advocates of certain retorts make the boast that they yield enough fuel gases to do the retorting. This boast means simply that they are doing poor retorting—making fixed gases instead of condensable gases, and by the same token are getting a low yield and inferior oil. It is infinitely better to secure as high a yield as possible of condensable gases—in other words to accomplish the purpose for which retorting is done, namely, to make oil, and that of the highest grade possible. If fuel is needed it can be made to much better advantage and of better quality by installing a producer plant using shales as raw material. A single producer plant would supply several retorts.

It is impossible to avoid the formation of fixed gases, but if the retorting is properly done the volume need not exceed 3,000 to 4,000 cubic feet per ton of shale, depending upon its normal yield of oil. The proportion of hydrocarbons in this should not exceed 35 per cent. If a successful effort is made to convert fixed carbon into combustible gases the volume will be larger.

Ammonia Yield

A large number of analyses of Colorado shales show an average nitrogen content of 0.6 per cent., which

would correspond to 56 pounds of ammonium sulphate per ton. Only a part of the nitrogen is available for the formation of ammonium sulphate—probably not more than one-half. In retorting, a part of the available ammonia comes off at low temperature, and a part at high temperature. Superheated steam increases the yield of ammonia from two to three times, but a large part of it comes off at the high temperature. Unless it is found desirable and profitable to use the high temperature for the purposes of oil extraction it may be doubtful whether the increased yield of ammonia would justify the high heating which would surely injuriously affect the hydrocarbon gases if they were heated to the same degree. Under certain conditions of market and demand for ammonium sulphate it might be profitable to pass the shales directly from the main retort into a separate finishing chamber in which the ammonium sulphate could be secured. The gases formed could be turned directly into the fuel supply.

Other By-Products

Much nonsense has been written about the many valuable by-products of oil shales. It is true that many commercial products can be made from the shales, but most of those commonly listed can be made more cheaply from other forms of raw materials. This is true of dyestuffs, medicinal salts and many other chemical substances.

A substance resembling ichthyol has been made, but it is very doubtful whether true ichthyol has been produced.

Synthetic rubber has been much talked of but it is safe to say that nothing approaching a commercial process or a commercial quantity has been discovered.

A substance resembling gilsonite and possibly suitable for a rubber filler may be separated from the tarry residues.

Paraffin wax of high grade and readily marketable may be produced in commercial amount and profitably.

Analyses of several samples of spent shale showed an average potash content of eighteen pounds per ton of spent shale. This is water-soluble and could be leached out at little cost.

The spent shale has been proclaimed a fertilizer, but it contains nothing of value in this way except the potash and it would be absurd to list it with fertilizers.

It has also been talked of as raw cement material, and as brick material. It is of less than average value for either of these purposes.

One advertiser of shale oil stock has found that it is the best of material for glass and porcelain making. This is nonsense.

It is not even good road material and its disposition will present a problem.

The tars, still carbons, or coke and the heavy residual oils will be utilized about the plants or converted into marketable products.

Lubricating oils of the highest grade are made from the Scottish shale oils, and laboratory quantities of lubricating oils made from Colorado shale oils have been given extraordinary results when tested in actual use. They retain their viscosity or body at much higher temperatures than do oils of similar density and flash point made from well petroleum.

Much information is being given out regarding the precious metal content of the spent shales. A large number of assays by thoroughly reliable and competent chemists and assayers, have failed to give a single return which could by any reasonable means be called commercial. Traces of gold were found in possibly one-half of the twenty-two tests made by the Colorado Geological Survey.

Refining Problems

The problems of refining may be summed up:

(1) To refine without undue waste an oil containing from 50 to 70 per cent. of unsaturated hydrocarbons, a considerable percentage of pyridines and other compounds; (2) to secure good color and permanence of color; (3) to secure a reasonably sweet odor; (4) to secure an oil which will not corrode the cylinders of the engines in which it is used; (5) to secure the largest possible percentage of valuable, marketable products from the crude.

It has been shown—that the unsaturated hydrocarbons (olefins) yield more energy, and yield it in a steadier and more sustained thrust, than do the paraffin hydrocarbons; that an olefin gasoline of the same gravity will vaporize more readily, and is therefore a better winter motor fuel than a paraffin gasoline; that the shale lubricating oils, rich in olefins, hold their body (or viscosity) better under high frictional heat than do the paraffin-rich lubricating oils of the same density, and are, therefore, from this standpoint more desirable lubricants.

It is evident, then, that the first problem of the refiner is to work out a refining process which will save all the olefins and give the user the benefit of their superior qualities, whether in the engines or on the bearings. The Scotch shale oil producers are doing this, and it is entirely reasonable to say that the American refiner can and will do it.

Shale Oil Gasoline

Today the makers of cracked gasoline are putting on the market a good looking and well-behaved gasoline containing over 20 per cent. of olefins. If they can do this the shale oil refiner can surely meet his problem. But it must be remembered that shale oils contain constituents which are not found in well petroleum, and these must be taken into account. In the laboratory this has been done, and the gasoline is water-white and "sweet-smelling" after eighteen months. Commercial refining is a somewhat different problem, but there is no reason for discouragement. It can be done commercially.

A well-made crude shale oil should yield from 16% to 22% of motor spirit, or gasoline, and about 40% of the kerosene fraction. These will contain roughly 60% to 70% olefins. If the kerosene is not desired a fraction containing it and a small percentage of even heavier distillate may be taken off and cracked. The resulting gasoline will bring the total yield of gasoline up to 40% or over.

The odor of shale gasoline is not like that of common gasoline, but it is not more unpleasant. Some people believe it induces headache more readily, but it need not be used as a perfume or as a substitute for smelling salts.

The color problem appears to many experimenters very serious. It is hard to remove the dark brownish-purple color which characterizes the light fractions of shale oil, but it has been and can be done. Is this coloring matter injurious? Must it be removed? In the early days of the Pennsylvania oil industry the kerosenes put on the market were of many shades of color from water-white to greenish, violet, bluish and reddish. Did the color affect the quality? Refiners say it did not.

It may be that a campaign of education would remove the color problem.

It has been said that shale gasoline has a corroding effect on the motor. This is specifically denied by oil

technologists familiar with the facts. Tests were made in the Geological Survey laboratory with laboratory-made shale gasoline from Colorado shales and no injurious results could be found.

Another problem of the refiner is to secure the largest possible yield of marketable products from the shale oil. Only a few years ago kerosene was practically the only marketed product from well petroleum. Today such products are legion, and the profits are millionaire-making. It is entirely probable that many similar by-products will be made from shale oil. At present gasoline, kerosene, lubricating oils, waxes, tars and cokes may reasonably be counted upon as commercial products. Hundreds of others are chemically possible since shale oil is even more complex than is well petroleum, but many of the chemical possibilities do not appear to be commercial possibilities since the substances can be produced more cheaply from other raw materials.

Conclusion

The fundamental problems of the shale oil industry are solved. Details will have to be worked out, and apparatus and manipulation will have to be modified to meet the peculiarities of our various American shales. In the opinion of the writer the retorting presents fewer difficulties than does the refining. But many of the refining problems will vanish if the retorting is done scientifically and in obedience to chemical laws. It must not be supposed that the same methods of refining can be successfully applied to oils which are chemically very different. If this is kept in mind and the chemistry of the unsaturated hydrocarbons is mastered the refining problems will very soon yield to chemical skill.

Paper Manufacture in Louisiana

The Great Southern Lumber Co. and the Bogalusa Paper Co., owned by New York, Pennsylvania and Maryland capitalists, with headquarters at Harrisburg, Pa., will put into effect an investment and conservation policy at its immense timber holdings, aggregating 221,000 acres of virgin pine timber land and timber rights in the Bogalusa, La., region, which will be notable in southern industrial progress.

Supplementary to the operation of a \$3,500,000 lumber mill at Bogalusa, with a daily capacity of 1,000,000 feet of timber, is the plant of the Bogalusa Paper Co., with a present daily capacity of 125 tons of container liner. Four additional units to the paper mill will be built, involving an investment of \$8,000,000. Each unit will have a daily capacity of 125 tons and will be devoted respectively to high-grade book paper, heavy wrapping paper, card board, and undetermined.

Reforestation of cut overland not suitable for agriculture will be practiced, with the result that with 25 years more standing timber at the present rate of consumption, the new growth of loblolly pine maturing to pulp wood size in 15 years, will be available.

The Great Southern Lumber Company is capitalized at \$10,000,000, and its directors include W. P. Cooke, Ganson Depew, F. H. Goodyear, A. B. Watson and C. W. Goodyear, all of Buffalo, N. Y.; W. H. Sullivan, of Bogalusa; J. Grady, of Warren, Pa.; L. S. Hart, of Harrisburg, Pa.; H. H. Redfield and Orlo J. Hamlin, of Smethport, Pa.; F. L. Peck, of Scranton, Pa.; C. I. James, of Baltimore. W. P. Cook is president, Chas. I. James is first, C. W. Goodyear is second, and W. H. Sullivan is third, vice-president and general manager. F. A. Lehr, of Buffalo, is secretary and treasurer.

Work of the Chemist in the Hercules Powder Co.

Administrative Personnel of the Chemical Department and Methods of Production Control of a Widely Scattered Organization



George M. Norman
Penn. State College, 1895-99,
Chemist, Univ. of Wisconsin,
1903-05,
Chemical Director.

ally located in all parts of the country to supply most efficiently the demands of the mining and quarrying industries which are the largest users of its products.

In the following tables are shown the geographical distribution and production capacities of plants producing high explosives and black powder:

High Explosives Plants

Location	Capacity, Lbs. Per Month
Kenvil, N. J.*	1,500,000
Carthage, Mo.	1,500,000
Bacchus, Utah	1,250,000
Hercules, Calif.	3,500,000
Total Monthly Capacity	7,750,000
Total, Lbs. Per Year	93,000,000

*Manufactures smokeless powder as well as dynamite.

Black Blasting Powder Plants

Location	Capacity Kegs ¹ Per Day
Turck, Kan.	1,750
Ferndale, Pa.	950
Marlow, Tenn.	900
Pleasant Prairie, Wis.	1,800
Youngstown, Ohio	850
Valley Falls, N. Y. ²	375
Hercules, Calif.	1,200
Bacchus, Utah	600
Total kegs per day	8,425

¹Capacity of keg is 25 lbs. ²Black sporting powder.

The manufacture of nitrocellulose and nitrocellulose solutions is carried on at Gillespie, N. J., near New Brunswick. N. J. In June, 1920, the company entered the naval stores field as described by W. R. James of the Hercules Powder

Co., in the April issue, of CHEMICAL AGE. At this time the plant of the Yaryan Rosin & Turpentine Co. at Brunswick, Ga., was taken over.

Active operations in this field also are carried on in Mississippi at Gulfport and Hattiesburg; the plant at the latter place is now approaching completion.

Chemical Control

The chemical department is under the administration of G. M. Norman, chemical director, W. C. Hunt, assistant chemical director, and E. M. Symmes, J. L. Bennett, H. N. Marsh and J. T. Moore, all located at the home office at Wilmington, Del.; and C. F. Bierbauer, assisted by H. F. Kaiser, in charge of the Experimental Station located at Kenvil, N. J., near Dover, N. J.

The Experimental Station is provided with very complete laboratories and experimental buildings, housing apparatus of all sizes and kinds necessary to carry out development work after it has passed the laboratory stage.

The extensive testing equipment of the high explosives section comprises a Bichel pressure gauge, calimetric bomb, Mettagang rate-of-detonation recorder, ballistic mortar, water-resistance testing machine, a low-temperature magazine for testing resistance of explosives to freezing, and a plot covered with fine sand for conducting the shots for sensitiveness and velocity.

There also is a complete nitroglycerin plant on a semi-works scale so that experimental work on yields, costs and new liquid explosives can be done on a scale comparable to that of actual manufacture.

With the object of developing business for the nitrocellulose plant located at Gillespie, N. J., which was erected during the war for the manufacture of smokeless powder, experiments have been carried on for some months with the view of utilizing such nitrocellulose equipment for the manufacture of celluloid. The course followed in this work is similar to that followed in all experimental work undertaken by the company, in that it is first conducted on a small laboratory scale and then passes to successively larger scales until the operation reaches full sized apparatus and on a semi-commercial basis, the product being sold in the open market as is the case at present.



W. C. Hunt
Case School of Applied Science,
1903-07, Chemical Engineer,
Asst. Chemical Director.



J. L. Bennett
Univ. of Kansas, 1910-14,
Chemical Engineer,
in charge of Acid Control and
Operation.

The work of the company in the naval stores field is of peculiar interest in that it represents intensive utilization of heretofore neglected material, viz., stumps, made compulsory by the previous wasteful methods in the collection and utilization of pine tree resin. An important secondary aspect is the added availability to southern agriculture of land cleared of stumps and waste

pine timber. At the present time some of the questions in this field under investigation at the Experimental Station are improvements in the quality and uniformity of rosin grades, and of turpentine, increased yields of both from the raw wood, improved methods of extraction and utilization of the extracted chips at present being used for fuel, but which may prove suitable for paper pulp, wood pulp or meal, alcohol, etc.

Administrative Personnel and Division of the Work

George M. Norman, chemical director, prior to his association with the du Pont organization in 1905 as a chemist in the acid department at the Repauno plant, Gibbstown, N. J., served with the Illinois Steel Co., South Chicago, Ill., Tennessee Coal & Iron Co., Birmingham, Ala., and with the General Chemical Co. at Camden, N. J. His association with the Hercules Powder Co. dates from 1913, since when his administrative ability in the strenuous period of war-time production marked him as a man fit for control. W. C. Hunt, assistant chemical director, handles matters pertaining to smokeless powder in both testing and experimental development.

Upon E. M. Symmes devolves all questions arising in connection with high explosives. J. L. Bennett is responsible for chemical control and the operation and manufacture of nitroglycerin, nitric and sulphuric acids and ammonium nitrate, and the recovery of nitric and sulphuric acids from the spent acids of nitroglycerin and nitrocellulose manufacture.

H. N. Marsh handles all matters pertaining to the supervision of works laboratories and of methods used in control analyses. J. T. Moore directs the actual work-out in the plants of the installations of new processes or of changes in methods made necessary by the results of experimental work. C. F. Bierbauer is located at Kenvil, N. J., and is in charge of the Experimental Plant where most of the experimental work done by the company is performed.

L. N. Bent, with the title of Assistant to the General Manager, has entire charge of all the naval stores operations, the associated chemical investigations of which are carried on at the Experimental Station, and at the laboratory of the principal plant at Brunswick, Ga. I. W. Humphrey, of the Experimental

Station staff, has charge of the latter work, assisted by five or six technical men. Dr. C. M. Sherwood, located at the Brunswick plant, directs the work at that point.

Explosives

Dynamite as it is now known contains nitroglycerin in quantities varying with the rated strength of the dynamite, and an absorbent composed of a mixture of carbonaceous materials which will be consumed by the nitrates during the explosion. Sometimes a considerable proportion of the nitroglycerin in the dynamite is replaced by nitrate of ammonia, which in such a combination becomes a true explosive. Such alteration changes the characteristics of the explosive, making its rate of detonation lower and rendering it more suitable for some kinds of work.

Gelatin dynamite differs chiefly in that it has a small amount of soluble nitrocellulose added to the mixture before incorporation, which nitrocellulose, in combination with the nitroglycerin, produces a jelly. This jelly, when thoroughly mixed with the other ingredients, makes a material resembling dough. Such an explosive is not attacked by water, and can even be placed under water for a considerable length of time without change.

Work of the Chemical Department

The quality of the ingredients used in all explosives is maintained by strict chemical control. Variations in composition and physical characteristics alter explosives to a marked degree. This particularly is true of moisture which must be kept to the lowest possible minimum since explosives containing considerable moisture when incorporated, or which have taken up moisture after manufacture, rapidly become weak and insensitive with age.

The control laboratory at each plant checks such points daily, as well as testing the finished product for proper analysis and sensitiveness, which is its ability to shoot under conditions in actual use. Products which do not come up to the specified tests are not considered fit for shipment to the storage magazine for sale, without further treatment.

The control of laboratories located at the various plants is under the direction of the plant superintendent, but the Chemical Department supervises the work by means of numerous reports and the shipment from the Experimental Station of test or check samples of known composition representative of the materials passing through such laboratory. On the receipt of the results of such analyses from the various control laboratories, the Chemical Department issues



E. M. Symmes

Mass. Institute of Technology,
1907-11, Chemist.
In charge of High Explosives.



C. F. Bierbauer

Penn. State College, Chemical
Engineer.
In charge of Experiment Station,
Kenvil, N. J.,



Henry N. Marsh

Univ. of Kentucky, 1910-14,
Chemical Engineer.
In charge of Plant Laboratories
and Control Reports.

a tabulation comparing the results and showing the relative standing in regard to the accuracy of each plant.

An inspection is also made of each plant-control laboratory at least once and sometimes twice a year by a representative from the analytical department of the Experimental Station in order to insure that the standard methods of analysis are being followed.

Each month each plant sends to the Chemical Department a detailed chemical-yield report covering such operations as the manufacture of nitric and sulphuric acids, nitrate of ammonia, nitroglycerine, recovery of sulphuric and nitric acids from spent acids, manufacture of nitrocellulose, etc., showing the consumption of each essential ingredient used to manufacture a pound of the above mentioned materials and the percentage yield obtained, together with the various other items of interest, such as fuel consumption, amount of repairs, power consumption, etc.

The Chemical Department, using these reports as a basis, prepares a tabulation showing the cost per pound of each of the above mentioned manufactured materials, using an arbitrary fixed price for the necessary ingredients, which price is the same for all plants, so that a comparative standing of the plant manufacture can be made, both on the basis of costs and percentage yields. Inasmuch as yields and costs are interdependent to a great extent, it is evident that a plant might

obtain a high yield of nitric acid based on the sodium nitrate consumed, and at the same time might have a very high production cost due to the use of an excessive quantity of sulphuric acid to drive this nitric acid out of the sodium nitrate. The above procedure takes this into consideration.

An important part of the work of the Chemical Department lies in assistance to the Service Branch of the Sales Department, in sending out when necessary men particularly skilled in certain lines to assist the customer in overcoming his troubles.

The Chemical Department employs and trains all new chemists needed by the company, so that there is always available and in training a man fitted to step into the next higher position. This training consists in first locating the new men either at Experimental Station or the plant laboratories and letting them become accustomed and trained in the company's policies as well as the laboratory routine, so that by the time they are called upon to take a more important position they will be familiar with the company's policies.

Another activity of the Chemical Department is co-operation with the Engineering Department in the design either of improved apparatus or equipment for new processes which have just left the development stage at the Experimental Station and which are ready to be constructed on a plant manufacturing scale.

Carbon Black Industry in Louisiana

The rush of the Southern Carbon Co. to complete the construction of eight carbon black units at Swartz, La., in addition to its six units at Fairbanks, five at Spyker and three at Perryville in that state, together with the completion of the new plant at Sterlington, La., by the Sterling Carbon Co., lends interest to the address of Hon. M. L. Alexander, Commissioner of Conservation of Louisiana, before the American Institute of Chemical Engineers at New Orleans. Commissioner Alexander, in discussing the gas resources of the state, said:

"The natural gas fields of Louisiana are considered to be the greatest gas fields in the United States. The principal fields are located in Caddo, Bossier, Cuachita, Morehouse and Terrebonne Parishes. The Terrebonne field has yielded wells of the largest volume, some of them having been estimated to have a volume of 90,000,000 cu. ft. per day. The Cuachita-Morehouse field, approximately 30 miles long and 18 to 20 miles wide, I think unquestionably is the greatest gas field known, with wells ranging from 4,000,000 to 40,000,000 feet in daily capacity, with only one failure recorded.

"The protection of this great natural gas asset, with its billions of feet of gas in reserve, has become one of our most serious problems. It is a well recognized fact that natural gas primarily is an asset of the people. It is an asset that can give more real return to a greater number of people when used for domestic consumption than any one thing. The question is, therefore, have we, who may be termed the guardians of the people, the right to permit the use of natural gas in the manufacture of these things which mean little in a direct way to the community or the state.

"I have in mind the use of natural gas for the manufacture of carbon black. There are possibly ten plants in the state now making carbon black from natural gas. They are consuming 70,000,000 cu. ft. of gas per day. Unless some check is made upon this consumption, there will be twenty of these plants within another year, which would consume 140,000,000 to 150,000,000 cu. ft. of gas per day. At this rate, the entire supply of natural gas would be used for the manufacture of car-

bon black within a period of a few years, whereas the economic distribution of this gas throughout the state would be of untold benefit to hundreds of thousands of citizens for a long period of time.

"It is not the desire or the purpose of the state to hoard this natural supply of gas, and where it is found in isolated localities, the state is willing to permit its use for other than domestic consumption. But it is the purpose of the state to conserve the gas and to make it of economic value to its people. A carbon plant costing a large sum of money to erect and put in operation, using from five to ten million cubic feet of gas per day, will employ only a limited number of people, meaning practically nothing to the industrial upbuilding of a community, whereas other industries using ten times less gas and employing ten times more people would mean much to the industrial development of the state.

"The state is now requiring all carbon plants using natural gas to extract first the gasoline content before burning the gas for carbon. It is further requiring all carbon companies to secure first a permit before erecting their plants, and these permits to be renewed every twelve months, renewal dependent upon the supply of gas. The experience of other states has been a valuable lesson to us on this question."

In the period from October, 1914, to October, 1920, the pay of factory workers in New York State increased 126 per cent., while that of factory office employees increased only 62 per cent.

* * *

The American Chicle Co., 19 West 44th street, New York, has disposed of its plants in Cleveland and Kansas City, and will concentrate its chewing gum manufacture in its Long Island City, N. Y., and Chicago plants.

* * *

The American Vat Color Co., 2536 Calumet avenue, Chicago, Ill., capital \$600,000, has been incorporated to manufacture and deal in dyes. It has taken over the business of a copartnership trading as the American Vat Dye Co. at the above address and that of Theodore Revillon & Co., a Delaware corporation.

Training Foremen for the Chemical Industries

By Allen Rogers, Ph.D.

Pratt Institute, Brooklyn, N. Y.

THE growing tendency of modern education is to give instruction along those lines which will bring the student into as close touch as possible with the actual working conditions, and should be so conducted that the theoretical subjects studied harmonize with their practical application. For many years this method has been in vogue where engineering subjects were concerned, but has only recently been introduced into chemical courses.

It is not within the province of this article to dwell upon the modified courses of chemical instruction, as given in many of our technical schools nor to mention the excellent research work which is being carried out along lines having a direct bearing upon industrial conditions, but rather to discuss that phase of the subject which is close to the writer's heart and which, from the start, has been a radical departure from the usual methods of chemical instruction. The writer humbly begs your indulgence for going into details when referring to his work, but he feels that in order to make his point clear it will be necessary to give a slight description of the methods which are employed to bring about the desired condition.

In September, 1905, the Pratt Institute inaugurated a new course known as "Applied Chemistry," at which time the writer was appointed to take charge of the Industrial Chemistry. He was told to equip his laboratory and so arrange his course as to give the student a training in such lines as would have a practical bearing upon manufacturing operations, and which would fit them to become foremen, superintendents, and heads of departments in our numerous chemical industries.

As no other schools were giving such a course it became a matter of originality, to work out the details of which was no small undertaking. To meet the demand of a large number of young men who could not afford the time or money for a four year course with college requirements the course was made but two years in length, and only such subjects included as had a direct relation to manufacturing operations. To afford the necessary practical instruction for the course, five miniature factories were installed, consisting of chemical works, soap works, dye works, paint and color works, and a tannery, to which has since been added other equipment for special purposes.

During the first year of the course the student is given instruction in general and analytical chemistry, with such mathematics, physics, mechanical drawing and shop work as will assist him properly to understand the practical instruction to follow. It is in the second year, however, that he meets with the applied subjects which bring him into closer contact with the problems of the day and fits him to enter the production end of the chemical industry.

At the opening of the second year the class is divided into groups, one half being assigned to the Technical Laboratory and one-half to the Industrial Laboratory. Each group works in the respective laboratory at two week periods.

While in the industrial laboratory the group is again divided into smaller groups, comprised of about five men, one of the number being foreman. For sake of illustration, suppose we consider the groups assigned to the chemical works.

The Chemical Works Foreman

Here the preparation of chemicals is carried out on a fairly large scale, and the students become familiar with the handling of steamjacketed kettles, vacuum pans, vacuum pump, vacuum filter, filter press, stills, centrifugal machine and drying ovens. It is not only the idea of showing how certain chemicals are made, but the broader question of operating typical apparatus, which is of the most importance.

The foremanship system is of value, as it gives the student experience in handling men and assuming responsibility. All orders, also, are given directly to the foreman, who, in turn, must transmit them to his men and must see that they carry out each operation with accuracy and dispatch. It is part of his duty, likewise, to see that his men are kept busy, that his factory is kept clean, that his machinery is in perfect condition and that all products manufactured should be made at a profit. The student assigned as oiler each week also reports to the foreman for instruction. As one group of men finish the assignment in the chemical works another takes its place and so the work continues.

The Technical Laboratory Supplements the School Factory

That part of the class not employed in the industrial laboratory is engaged on analytical problems in the technical laboratory, where they are required to make a complete analysis of such substances as water, gas, coal, cement, soap, oils, pigments, paints, tanning materials and other commercial products. It is the belief of the writer that the analysis of such materials not only familiarizes the student with common analytical problems, but at the same time gives him experience in quantitative separations, which will apply to unknown substances more readily than if he had been given abstract analytical problems to solve; and further, as these are some of the common substances encountered in the works laboratory he is prepared from the start to undertake such analysis. It is not the object of this course, however, to turn out analytical chemists, and this training simply supplements the more important industrial instruction.

The Soap Factory Foreman

When the first group of students have remained in the technical laboratory for two weeks they are assigned to the industrial laboratory again, but this time to the soap factory. In this factory not only are the various kinds of soaps prepared with the various corresponding instructions regarding the value of the fats employed and the theory of saponification explained, but the student becomes familiar with the apparatus and machinery used in this industry. In this plant he is given more confidence in himself than in the chemical works, for the product which he makes must be of the highest quality to escape the criticism of his classmates, and, what is still more important, it must be good enough to sell.

During the year about 4,000 pounds of toilet soap is made in this model soap factory, all of which finds a ready market. The equipment of the soap factory consists of an eighty gallon lye tank, five hundred pound

kettle, one hundred pound crutcher, frames, slabber, cutting machine, chipper, stone mill, plodder and press.

Paint and Color Works Foreman

Next in order comes the paint and color works, the equipment for which consists of color tanks, filter press, pebble mill, kneading machine, change-can mixer, iron mill, two water-cooled 20-inch buhr stone mills and liquor mixer. During the year about 400 gallons of ready mixed paints are made by the students at work in this factory, all of which is sold and gives entire satisfaction.

The Tannery Foreman

To the model tannery the group is next assigned. Various processes of vegetable and mineral tannages are carried out, together with all operations involved, from the raw material to the finished product. The equipment for this factory consists of a leach house, soak pits, lime pits, suspender pits, layer pits, paddles, mills, fleshing machine, shaving machine, union splitter, setting out machine, staking machine, rolling jacks, glazing jack, buffing wheels, and measuring machine. Special rooms are also provided for finishing, drying and tacking.

As will be noticed, the equipment for this line of work is more extensive than the others. The reason for this larger equipment is due to the fact that the National Association of Tanners co-operated for eight years with the Institute in providing special training for young men going into their industry. The work was suspended during the war, and steps are now being taken by the association to establish a school of their own, which will follow very closely along the lines originally developed at Pratt Institute.

Oil-Cracking Plant

In addition to work in the regular model factories many special problems are studied. For example, during the last year a model plant for the cracking and distillation of petroleum oil was built and operated as part of the instruction. All of the brick work, pipe fitting and carpenter work necessary was done by the second year students. This year the petroleum refining is being enlarged and a plant for the production of industrial alcohol is under construction.

By the end of the winter term each student has worked in all the model factories and has finished his instruction in dyeing, so that for the remainder of the year his time is devoted exclusively to that industry in which he intends to specialize.

Criticism Considered

Like all new undertakings this method of instruction has been criticised, especially by those who have not taken the trouble to investigate the methods followed and the object to be attained. It has been said that it is nonsense to teach a young man a little about soap, a little about dyeing, a little about paint, and a little about leather. This perhaps would be nonsense if it were all that the course accomplished, but such is not the case.

Up to the time that the student begins to specialize, it is not so much what he learns about any particular industry, but it is what he learns about operating typical machinery, handling men, assuming responsibility, and gaining self-reliance that counts. In other words, he is brought into touch with manufacturing operation; he handles material on a sufficiently large scale to produce something which has commercial value. If through carelessness or failure to follow directions he

spoils a lot of goods it means an actual loss in dollars and cents, which, in a factory, would be very apt to cost him his job. That this method develops self confidence is evident by the pride and interest which each foreman, and his men as well, take in the product manufactured, especially when the product is of fine quality. It is also gratifying to note the disappointment when the product is not up to the standard, or the cost of production exceeds the price received for the finished article.

When the student begins to specialize, however, a different condition obtains, and he then does learn not a little, but very much about the particular industry into which he hopes to enter for his life's work. It should be plainly understood that no school can turn out experienced paint makers, or expert tanners, but that the training received so fits the young men that they readily can adapt themselves to the conditions encountered in the manufacturing plant.

Results and Aims

Of the five hundred-odd young men who have taken the course, over ninety-seven per cent. are engaged in chemical industry. Of this number over seventy per cent. are employed in the works, while the remainder hold laboratory positions. The positions held by these men are managers, assistant managers, superintendents, assistant superintendents, foremen, helpers, and chemists.

Although many of the graduates go into analytical lines, we do not make this our aim, for we feel that that field belongs to the colleges and technical schools. The one great object which always is uppermost and for which we constantly are striving is to train young men for responsible positions in the factory, where, by reason of their technical training, they will be able to work more intelligently and in sympathy with the chemist, who, under present conditions, often finds it impossible even to try out his ideas in a practical way, owing to the non-receptive attitude taken by those who have the practical work in hand.

Commercial Plant Conditions

Three out of five foremen today will do all in their power to make any experiment go wrong which has been suggested by the chemist; while men in even higher positions will often disparage the efforts of the chemist and take the advice of the so-called practical man. Often, sad to say, the chemist is wrong, but usually for the reason that he has been given no opportunity to become familiar with the actual working conditions.

This statement is no idle dream and can be vouched for by the writer's own experience, as well as from scores of similar cases which have been brought to his attention by other chemists who all have had some such experience. To mention a few of only many instances will serve to illustrate the difficulty and discouraging conditions which are sometimes encountered by the chemist. A chemist for one of the large varnish factories near New York City had worked out a formula for making what to him appeared to be a very high grade product. He turned the formula over to the varnish maker with the request that he make up a batch in a practical way. The varnish was made, but when tested failed absolutely to give the anticipated results. On making an investigation it was found that rosin had been intentionally substituted for the fossil gum that was designated in the formula.

In a tannery, when a pack of skins were being treated by a new process of bating, the foreman turned in

straw so as to convert the stock into gelatin, and then claimed that the process had dissolved the skins. So other instances could be cited, but it is not worth while to burden the reader with details of this kind.

The Importance of Tact

It may be asked, why does such a condition exist? To my mind, there are two reasons: First, the average foreman or superintendent, in being very zealous of what he knows, is afraid that someone higher up will discredit his ability, while at the same time he may fear that the chemist will get his job. Second, the chemist is often to blame as he approaches the man with an "I know everything" attitude, which, from the start, antagonizes the one with whom he should be on friendly terms. It is therefore the duty of the foreman, the superintendent, the heads of departments and the chemist to work together for the common good.

We are a nation of vast resources, and if we wish to conserve them we must improve our factory conditions. Not only must we have the trained chemist, with his scientific and technical knowledge, but we must have technically trained and intelligent workmen as well. The foreman who works by rule-of-thumb is no better than a machine, but the man who uses the brains which God gave him and knows what he is doing will not only make a better product, but will be capable of grasping the details of the technical points involved.

Conclusion

It is the humble opinion of the writer that the time

is fast approaching when all positions of responsibility will be held by men who have received a technical education, either in the university, college, technical school, trade school, or vocational institution, and especially from those schools which aim to emphasize the practical side of the technical subjects they are endeavoring to teach. For then the foreman, the superintendent and the chemist can talk in a language familiar to them all, and the details involved will no longer be shrouded in mystery.

There are those who believe that our high schools should take up this line of instruction. In doing this, however, we must not let our enthusiasm get the better of our good judgment, for if the idea were carried too far the high school would no longer stand for liberal education, and would certainly be a step in the wrong direction. There are some subjects, however, now taught in our high schools which readily could be supplanted by a certain amount of practical instruction and trade atmosphere. As the practical things of life usually appeal to young men and women, this course would have the tendency to keep their interest and stimulate a desire for further knowledge.

It also would cause them to realize that we are living in a busy world and that in a short time they, too, will become one of the cogs in the great wheel of industry. Local conditions would determine the nature of the instruction to be given, and we would find a larger number of young people finishing their high school education than we do today; with the result that we would not only have more intelligent employees, but at the same time better and more intelligent citizens.

American Institute of Chemistry

We are indebted to Dr. F. D. Crane, research chemist, 74 N. Willow St., Montclair, N. J., for the following questionnaire which is submitted by a committee of the New Jersey Chemical Society comprising with Dr. Crane, as chairman, G. T. Cottle and C. P. Titus, and is now being distributed. It was presented formally at the notable meeting of the New Jersey Chemical Society at Newark on Dec. 13, where it aroused discussion of a character that convinced its sponsors that they had given the initial impetus to a project of great potentialities of usefulness not only to the practicing chemist but to the industries predicated on the chemist's work.

At the October meeting of the New Jersey Chemical Society, a paper was read by Archibald Craig, of Ledoux & Co., New York, on the "Status of the Analytical Chemist," which pointed out the need of a closer affiliation among chemists. It was resolved that a committee be appointed to take action to ascertain if it is advisable to form an American Institute of Chemistry. According to the Committee's statement, such an organization could:

I. List on request and without charge (a) all persons who wished to be considered chemists in any sense of the word, (b) all chemical products, (c) all chemical industries, these lists to be public.

II. Register any chemist who would furnish a certain amount of definite, accurate information as to education and experience; such information and all other pertinent facts to be subject to independent investigation and to be available to inquirers under reasonable regulations. For registration a moderate fee would be charged.

III. Certify chemists of various kinds of chemical education and experience, after the candidate had passed a definite examination suited to the grade of certificate desired. For these examinations reasonable fees would be charged.

IV. Legalize the practice of chemistry in its various grades, by securing the proper legislation in national and state legislatures.

V. Co-operate with all institutions training chemists in order to harmonize courses of instruction, and with institutions and chemical societies to interest employers in properly trained chemists without, however, acting as an employment agency.

Such an Institute of Chemistry, Dr. Crane states, would, in the first instance, consist of a self-perpetrating body of, say, fifty chemists, nominated by the existing chemical organizations, with the understanding that after five years one-half the vacancies would be filled from the certified chemists; after ten years all vacancies would be so filled.

The Committee for the New Jersey Chemical Society desires the well-reasoned opinion of every chemically educated man and requests that answers to the following questions be sent to it at 74 N. Willow St., Montclair, N. J.:

1. Should an Institute of Chemistry be established?
 - If so:
 - A. Should it function as outlined?
 - B. What else, if anything, should it do?
 - C. Should it be constituted as outlined?
 - D. How should it be financed?
 - If not:
2. Should anything be done?
 - If so: A. What?

The Bartholomay Co., Inc., will convert its Genesee brewery at Rochester, N. Y., into a vegetable oil refinery of 50 tons daily capacity; using the Baskerville process described in the September CHEMICAL AGE. H. E. Brown, 115 Broadway, N. Y., is in charge of the installation.

Propyl Alcohol from Petroleum

To make petroleum the raw material for a vast series of compounds, just as coal tar has been the avenue for many successful developments in dyes and synthetic products, has been the thought and aim of scores of research chemists.

Owing to the relative inertness of paraffin oil, chlorine has been looked upon with favor as a sufficiently vicious element to attack the paraffin structure and yield chlorinated products capable of further reaction to afford alcohols and esters. The manufacture of alcohols and esters in this manner has been quite extensively investigated both on a laboratory and a commercial scale.

It remained for Carleton Ellis, president of the New Jersey Chemical Society, to transmute this dream into a commercial process. In his paper before the December meeting of the New Jersey Chemical Society, Mr. Ellis described the work which had engaged his attention for several years and which has resulted in the commercial production of alcohol from the waste gases of the Burton cracking process for gasoline manufacture, which contain a considerable proportion of propylene, an unsaturated hydrocarbon, combining readily with sulphuric acid.

After experiments in the laboratory had progressed to the point where the feasibility of the process was determined in a satisfactory manner, arrangements were made for testing out the process on a semi-commercial scale at Bayonne, N. J.

An organization, the Melco Chemical Company, was formed for the development work and a small plant was erected alongside of the Tide Water Oil Company plant from which supplies of refinery gas were obtained. This gas was delivered to the testing plant by means of a pipe line running from the compressor house of the Tide Water plant to the absorption apparatus at the testing plant. As a result of the investigations on a larger scale thus made possible by the facilities of this plant progress was rapid.

The waste gas first is treated to remove hydrogen sulphide, after which it is passed through sulphuric acid of proper strength and at a low temperature to avoid too violent reaction of gas and acid. The propyl alcohol is distilled by the usual methods of rectification.

Not only can the isopropyl alcohol be oxidized directly to acetone, a valuable solvent for airplane varnish, but from it can be found a series of esters which undoubtedly will have considerable commercial importance.

Several other alcohols are produced in greater or less proportion, and of these the hexylenes have been found to have extremely valuable properties as a solvent for nitrocellulose.

The new alcohol, called petrohol, will compete directly with methanol as a solvent for gums and resins. While inherently poisonous, it is believed to be without the deadly effects of methanol. The present daily production at the Bayway refinery is reported as 250 gallons.

While the gasoline-cracking plants in the immediate vicinity of large cities easily can dispose of their gases for illuminating purposes, those at a greater distance produce quantities of gas which have only a heating value. Mr. Ellis' invention, while it affects only a small portion of the volume of the gas, conserves valuable material, and the remainder of the gas has lost little of this heating power. It is expected that it will be very widely employed and greatly increase our store of organic solvents.

A Chemist in Business Development Work



MAJOR E. HOLMES, PH.D.
Manager, Chemical Department, National Lime Association

The appointment of Dr. Major E. Holmes as manager of the chemical department of the National Lime Association, Washington, D. C., which is an organization of manufacturers of lime, 60 per cent. of the national production of which is consumed by the chemical and allied industries, represents a unique utilization of the potentialities of the chemically educated man.

Dr. Holmes' work is the promotion of lime consumption in the field of his department which he does by bringing to lime consumers in the chemical and allied industries information as to the fitness of his employers' products for their manifold purposes, and how and where they can be used most efficiently. This is a service of reciprocal benefit to both the maker and user of lime in its various forms.

The requirements of experience and capacity as a chemist and chemical engineer, the possession of the trained investigative instinct and of tact and the aptitude of the teacher, combined with salesmanship, make Dr. Holmes' selection for this work eminently fitting.

Dr. Holmes graduated from the University of Indiana in 1908 and then went to Cornell University as a member of the staff of instruction and graduate student in chemistry and chemical engineering. He received his master's degree in 1910, and began work as research engineer for the National Carbon Company at Cleveland, Ohio. During nine years in this connection, his experience extended to most of the departmental duties of a manufacturing plant. It included technical control of factory production, direction of scientific and technical research and development work, and the installation and operation of semi-plant processes. In 1919, Dr. Holmes returned to Cornell to complete the requirements for his doctor's degree, doing research work of a purely scientific nature.

In his work as manager of the chemical department, Dr. Holmes is in a position to co-operate effectively with producers and users of lime in the chemical and allied industries and in investigative work involving the chemical use of lime.

Prohibition Commissioner John F. Kramer's ruling that the sale of home-brew materials is illegal and puts the buyer and consumer in the category of the moonshiner, adds consternation to the discouragement of the brewing interests that have turned their plants into malt syrup factories for home-brew.

After the Eighteenth Amendment went into effect the majority of the Milwaukee, Wis., breweries decided that the manufacture of near-beer would be less profitable than making malt syrup, a combination of malt and corn in the proportion of 40 and 60, which could be used for making home brew. Special equipment was installed to meet the increasing demand which called for a daily consumption of 800,000 pounds.



View of Potato Flour Mill Storage Buildings on the Right

The Domestic Potato Flour Industry

REPORTED resumption of importation of potato flour from Holland directs attention to the present status and prospects of the domestic industry, which was born amidst the tumult of the economic derangement of war.

The estimated annual waste of 50,000,000 bushels of potatoes is a sufficiently important item in a policy of conservation to warrant serious consideration.

The utilization of this quantity of a valuable material is an actual addition to our available foodstuffs inasmuch as the grade of potatoes wasted is of the non-commercial size.

Potato Flour and Potato Starch

Domestic potato flour production, while closely allied to potato starch production, owing to their common source, rests upon distinct economic considerations. Potato flour is the product of the whole potato, thoroughly cleansed, cooked, dried and pulverized into a fine, creamy-yellow flour. Nothing having been removed save the water content, or added to the tuber, the flour therefrom contains the essential mineral salts and proteins removed from wheat in the modern process of milling.

Potato starch is a white to gray, uncooked, tasteless and odorless product, which, while possessing all the properties that make starch a valuable industrial and edible raw material, is without the properties that commend potato flour as a foodstuff of growing use in the baking industry.

The use of potato flour to the extent of 2-2.5 per cent. or 4-5 lbs. per barrel of flour, in admixture with wheat flour, admits of improved appearance, flavor, texture and keeping qualities in the bread, and hence, flour manufacture and the baking industry provide the chief consumption outlets for potato flour.

Analyses

The starch-content of the white or Irish potato varies from 15-25 per cent., the remaining ingredients being water, 75-85 per cent., proteins about 2 per cent., and fiber and mineral salts, 1-3 per cent. About 5 pounds of potatoes are required to produce 1 pound of flour, or about 12 pounds of flour per bushel of potatoes.

Average Analysis of Genuine Potato Flour.

	Per Cent.
Moisture	9.82
Ash (Mineral Salts).....	4.15
Protein	8.30
Fibre	2.09
Fat	.40
Carbohydrates (starch and sugar).....	75.15
Albumen	5.76

Average Composition of the Potato.¹

	Per Cent.
Water	78.3
Protein	2.2
Fat	.1
Total Carbohydrates.....	18.4
Fibre	.4
Ash	1.0

Average Composition of Forty Samples of Potato Ash.

	Per Cent.
CaO	1.0
K ₂ O	59.2
MgO	4.5
P ₂ O ₅	13.8
Na ₂ O	4.0
SO ₃	6.5

Since the per cent. of ash in the fresh potato is given as 1.0, in order to translate these figures to the fresh basis it is necessary to divide by 100, which would give us the following on the fresh basis.

Mineral Contents of the Fresh Potato.

	Per Cent.
CaO	0.01
K ₂ O	0.59
P ₂ O ₅	0.14
MgO	0.05
Na ₂ O	0.04
SO ₃	0.07

Analyses made by potato-flour producers show that in manufacture of flour from the potato practically all the mineral matter is retained, with the exception of a small portion of the potassium which evidently is dissolved out. The mineral composition of the fresh potato, practically speaking, would be the same as that of the flour.

Consumption of potato flour in America in the year preceding the war amounted to several million pounds imported entirely from Germany and Holland.

Primacy of Corn in America as the Source of Starch

The cheapest and most abundant source of starch is corn, of which the United States produces more than twice as much as the rest of the world. Without particular qualities to recommend its use, no other commercial source of starch can withstand the competition of corn. In European climatic and economic conditions the potato takes the place of corn and yields the same products, viz., starch, edible and industrial, glucose, dextrine, alcohol, lactic acid, etc.

The relative position of the potato in the industrial economy of Germany and the United States is shown in the following table:

	Germany	United States
Crop, 1914, bushels.....	1,674,000,000	410,000,000
Human consumption.....	28%	68%
Cattle feed.....	40%	5%
Lost from decay and freezing.....	10%	15%
Starch, glucose, dextrine....	4%	1%
Seed	12%	11%
Alcohol	6%	

¹From U. S. D. A. Bulletin No. 1000, Office of Experiment Stations. Analyses quoted from the Bulletin show no per cent. of chlorine. The analyses of different samples show an average of 0.04 per cent. chlorine in the fresh potato, or 4.00 per cent. in the ash.

While the potato is cultivated widely in the United States, prolific potato districts are few and widely separated, only about 6 per cent. of the world's crop being produced here. Ninety per cent. of the world's crop is raised in Europe, where climatic conditions and intensive cultivation permit a yield (400 bushels to our 100) that makes the potato indispensable as a chemical raw material.

Establishment of the Potato Flour Industry

The first potato plant in the United States was built in 1917 at Idaho Falls, Idaho, by the Food Products Co., Boise, Idaho, and began operations in April, 1918, as a result of the enterprise of Carl Feldhusen of Boise.

During the war a Russian chemist in the employ of the Duquesne Reduction Co., Pittsburgh, Pa., worked on the proposition to concentrate potatoes so that military forces could have fresh potatoes without transporting 80 per cent. of their bulk in water. A dehydrated potato at 20 cents a pound appearing more acceptable to the War Department than a bulk product at 7 cents, the subject was continued until after the armistice, when the Falk American Potato Flour Corporation, a subsidiary of the Duquesne Reduction and the Falk

companies, with headquarters at Pittsburgh, Pa., located its first potato flour plant at Cadillac, Mich. By taking over plants of local companies and by new construction the company now has plants also at Caribou, Me.; Wisconsin Rapids, Wis.; Bemidji, Minn.; Monte Vista, Col., and Idaho Falls, Idaho, with aggregate production capacity ranging from 8,000 to 25,000 pounds of potato flour daily at each plant. The only two other plants planning operations for this season are at Delta, Col., and Cowley, Wyo.

Future of the Domestic Industry

The continuance of an American potato flour industry depends entirely upon protective legislation. European potato flour can be laid on the dock at New York or Philadelphia for just a trifle more than is paid for the raw potato at the potato flour mills.

The function of the industry to utilize a cull, undersized product, formerly wasted, as a valuable foodstuff and thereby contributing not only to the conservation of our food supplies, but imparting stability to the production of an important crop, warrants the prompt and effective consideration of Congress in its revision of our tariff schedules as relates to potato flour.

Work of Bureau of Chemistry for Year Ending June 30, 1920

THE report of Dr. Carl L. Alsberg, chief of the Bureau of Chemistry of the Department of Agriculture, of the work of the Bureau for the year ending June 30, 1920, has been received. In his discussion of the work of the Bureau Dr. Alsberg says:

"The struggle to maintain efficiency despite mounting operating costs, rapid turnover of the personnel, and reduction of the force through resignations, for which inadequate salaries alone are responsible, has been the main characteristic of the year's work. The average salary for chemists is \$2,275 per annum, the minimum \$1,200, and the maximum \$4,500. The average salary for food and drug inspectors is \$1,840, the minimum \$1,400, and the maximum \$2,500. In addition, all employees upon a salary of \$2,500 or less receive, by special act of Congress, a bonus of \$250 per annum.

"On June 30, 1920, the staff of the bureau consisted of 593 persons, of whom 263 were chemists and technically trained men, 41 inspectors, 155 clerks, and 133 miscellaneous employees. During the year the bureau lost by resignation, transfer, or death 74 technically trained men, 12 inspectors, and 68 clerks. The total loss was 210 persons, which is 35 per cent. of the present force, and does not take into account a considerable number of vacancies.

Among those who resigned were the chief of the eastern food and drug inspection district; the chemist in charge of the color laboratory and his understudy; the chemist in charge of the food research laboratory; the chemist in charge of the office of State and municipal co-operation; the chiefs of the food and drug inspection stations at Denver and Baltimore; the chemist in charge of the plant chemical laboratory; the chief inspector for the central food and drug inspection district; the librarian; the executive in charge of the office of accounts and his understudy; and the secretary to the chief of the bureau. The chief of the New York station, one of the ablest and most respected chemists in the service, Albert F. Seeker, was lost by death.

In order to maintain the law enforcement work it has been necessary to reduce very materially the constructive research work of the bureau designed to promote efficiency in the food and drug industries and to develop new methods for the discovery and detection

of sophistication. This expedient has for the time being been successful so far as the apparent volume of work accomplished would seem to indicate, since the total number of cases recommended to the Solicitor for prosecution exceeded by 40 the total for last year, when a far larger number of cases was developed than in any previous year.

The neglect of research, which has been unavoidable, will inevitably in time impair the effectiveness of the enforcement of the law, since the bureau is dependent upon research for the means to combat new types of sophistication which are constantly appearing as methods and materials change with the evolution of the food and drug industries.

Finally, without its research work the bureau can not render to the general public, the farmer, and the food and drug manufacturer that consulting and advisory service concerning the chemistry and technology of foods and drugs, organic chemicals, agricultural chemistry, and a host of kindred subjects which the country has a right to expect. However, as the conduct of any individual research usually covers a period of years, the effect is not yet apparent in the bureau's research output as measured by the number of its publications during the year.

The bureau put out 7 department bulletins, 4 circulars, and 1 farmers' bulletin. In addition, the results of more than 75 investigations were made public, while those of over 50 are now in press. The experimental work upon a number of others has been completed. At the beginning of the fiscal year 15 applications for public service patents were pending. Twelve additional applications were filed during the year; 6 were granted, 6 denied, and 15 are pending.

The total appropriation for the bureau was \$1,391,500, of which about \$50,000 remained unexpended and reverted into the Treasury. The latter sum represents in the main moneys allotted for salaries but unexpended because vacancies due to resignations could not be filled promptly, or, indeed, in many cases, filled at all. Incidentally, it may be stated that for some time past there has not been a year when a portion of the bureau's appropriation has not remained unexpended. In 1918 it was as little as \$7,881.73, but in 1917 it was \$105,978.08."

The American Institute of Chemical Engineers

What It Has Been—What It Is—What It Should Be

By David Wesson, President

IN the good old days of long ago when every man of standing in this part* of the country had his special body servant, two colored boys were heard discussing their respective masters. The first was bragging about the great wealth his master, who was a rich planter, had accumulated. He ended up by saying: "Your boss is always traveling. Don't you know a rolling stone gathers no moss?" The answer came back quick as a flash, "It sure doesn't get any moss, but it gets a lot of polish just the same, and that is what your boss needs."

This remark applies in some respect to the Institute. When we take an excursion like the present one the railroads remove considerable of our moss, but the inspiration and broadening effect arising from close association with many master minds of our profession engaged in the various fields of industry, more than compensates for the time and lucre spent in attending this meeting.

One of the first objects of the Institute was to bring men together who has made good in their profession, so all might be benefited by mutual interchange of views.

Another object was the elevation of the profession to a position in the community commensurate with the services of its members.

Up to a year ago the Institute passed through a slow but steady growth. The high code of ethics and the standing of its members gave it a respected place, but there were not enough of us properly to do the work for which we seemed to be especially fitted.

Some of our far seeing members suggested that the Institute would carry more weight in important national affairs if the membership contained all those who were eligible. A modest campaign was started with the result that our total membership today numbers 454 as against 365 for a year ago, an increase of 24 per cent.

During the past year we have joined the Federated American Engineering Societies, whose object is to secure the co-operation of the prominent engineering societies of the country to utilize their possibilities for constructive work in great public service questions, in matters of transportation, conservation of natural resources and similar affairs.

We have given hearty support to the proposed reorganization of the Department of Interior into a Department of Public Works.

The Institute is backing the compilation of the Compendium of Critical Chemical and Physical Constants, which when completed will furnish a valuable storehouse of information and become a needed tool-chest for members of the profession.

The Institute also is acting to some extent in an advisory capacity to the government engineers having in charge the survey for the new Boston-Washington super-power project.

These facts are mentioned to show that at the present time the Institute is not merely a joy-ride association, but its activities are becoming of national importance.

There is no longer any question of the value of the work of the chemical engineers to the welfare of the country. There is, however, the great question as to

how it can be made of greater value. We all have seen what organized labor has done through the sheer strength of numbers and organization. Is it asking too much to have all those who are fitted by education, achievement and high character brought into one strong organization by becoming members of our Institute?

With the professional leaders of our chemical industries all working together toward one common end, an enormous influence for good can be exerted upon the educational, industrial, economic and legislative affairs of the country. The days have gone by when the Institute was regarded by some as a sort of excursion club for a select few.

The day has come when the Institute must take the lead in shaping the thought of the chemical industries of the country. To do this, it should count among its members all the qualified leaders of those industries. During the past year, we have made a fine start. Let us, therefore, keep up the good work of securing desirable members so we may better accomplish the work which lies before us.

New Jersey Chemical Society

The December meeting of the New Jersey Chemical Society at Newark, N. J., on the 13th inst., was notable for the large attendance attracted by importance of Carleton Ellis' initial description of his work in the production of a commercial alcohol from petroleum, described on page 464 of this issue of CHEMICAL AGE.

Dr. Maximilian Toch, professor of industrial chemistry, Cooper Union, New York, gave an informal talk on the rise of artistic painting in Egypt, explaining the number of pigments used and the methods which produced their permanency, and tracing the development of the art in later Egyptian and Grecian paintings. The purity and permanence of the colors of the pictorial art of the Renaissance were attributed to the simple nature of the pigments used and the method of application. Permanency in this class of work is possible only by consideration of the chemical nature of both pigment and vehicle.

The report of the committee on the organization of the American Institute of Chemistry disclosed that the project had been approved enthusiastically by all to whom it had been submitted, and that it was desired, pending a further report, to receive opinions from all who could be reached by a questionnaire which would be made the basis for a later definite statement of plan and purpose.

The Union Explosives Co., Clarksburg, W. Va., has been organized with a capital of \$500,000 to consolidate the Long Powder & Supply Co., Empire Powder Corporation and Ashcraft Transfer Co. It will maintain and operate the plants of the different companies at LeRoy, N. Y.; Easton, Pa.; Rochester, N. Y.; Morgantown and Wilsonburg, W. Va. Headquarters will be at Clarksburg. J. Edgar Long is president and treasurer; John A. Washington, executive vice-president and secretary; George P. Jones, vice-president in charge of operations; and H. B. Cooper, vice-president in charge of sales.

*Address before the American Institute of Chemical Engineers, December 6, New Orleans, La.

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A Consolidation of
The Chemical Engineer
and Chemical Age



WE challenge the truth of the recent widely-quoted statement of Herbert Hoover, which we characterize as mischievous, that "the vast repetitive operations of industry are dulling the human mind."

One's disposition to accept himself as a standard in his judgment of others should not obscure the virtues of what he condemns, or blind him to a recognition of its place in a system that provides the freest play to human aspirations; and to abandon which would mean reversion and to change which would transcend human experience, which is unthinkable.

The achievements of modern industry are predicated on the process of integration and coordination which involves specialization of function and coordination of parts, exemplified in its highest efficiency in the functions and structure of the human body, and in the civilized world by the dissemination of a comfort and culture unapproached in recorded time.

No one who has made a place for himself in factory work denies the monotony of the repetitive process.

We must understand, in a society preponderantly of the mediocre, that progress is the work of the exceptional and that their capacity to serve must be earned, and that those who have done the most and the best for all have sprung from the humble and the poorly endowed whose capacity anywhere does not rise above the repetitive and the need of a boss.

REPETITIVE work does not dull the mind. Such work in industry makes possible leisure which permits response to the world-wide educative process which creates the discontent with environment which is the soul of progress.

Does the factory executive see the dulling of the human mind in the making of drop-forgings and their assembly in the completed machine, in the filling of lard pails, or in the manufacture of canned goods?

Only he sees atrophy of the intellect where intellect hardly has begun to function, who fancies how irksome such a job would be to him.

Every individual in his growth is subject to the repetitive process. The longer he remains subject, either the more he needs its influence, or it is accepted as the normal condition. That many spend their working lives in its monotony is not to ascribe evil to a process that exists because it serves, but to declare their limitations.

That machines often require so little supplemental brains to complete a process, is the work of the engineer. For a leader among engineers to deplore the results of this work, betrays a loose grip on the biology and psychology which lie at the basis of economics.

OUR progressive standard of living is exemplified by the scarcity of "wheel-barrow" labor and farm help, from which class the bone and sinew of the country have been fed.

To permit class aggrandizement to restrict this accession of national strength, not only is to confess indifference and social inefficiency in our treatment of the immigrant, but to aggravate a distress that only work can cure.

Drastic restriction of the undesirable and judicious allocation of the desirable easily are possible without restricting the flow of men and women needed in our national economy.

Provision should be made for examination of fitness to be initiated by consular or other officials at the point of origin, which, with adequate facilities for the enforcement of present immigration laws at the port of entry, would relieve us of the political disgrace and the menace to industry involved in the prohibition of immigration.

TO prepare youth to live, Dr. Butler says, is the true business of education. To prepare youth to make a living, he declares, is very subordinate, and deplores the emphasis given it in the present *mode* of educational practice.

What Dr. Butler has in mind is wasted on the immaturity of college youth. What the pedagogue thinks he can teach only can be distilled from the individual's experience.

Life only can teach what Dr. Butler means. And when we have learned how to live many of us are old enough to die.

IN seeking to preempt the function of experience young men are thrown upon a selfish world with tastes and aspirations they constitutionally are unable to gratify.

If man's first duty is to be a good animal, a prime business of life is his maintenance; and the degree to which he succeeds is the measure of his usefulness.

A clearer, finer statement is that the true business of education is to prepare youth to be of service to his

fellows, for it connotes the practicality that makes possible the realization of ideals.

ORGANIC development and the relations of men in a progressive society are in accordance with well-recognized natural laws. Of the former the crowning achievement is man who in his organic development epitomizes the evolution of the race. The same laws operate in society and in every successful manufacturing organization. Tampering with these laws, or in any way restricting their free play, to effect any fancied improvement or correction of economic conditions, as a rule defeats its own ends.

Sound legislation, well-managed plants and wisely ordered conduct are predicated on these laws which thus aided contribute, as regards society, to the greatest good of the greatest number; as regards manufacture, to profit and growth in service; and as regards the individual, to usefulness and the esteem of his fellows.

BEFORE has died away the reverberation of the slogan, "Less government in business and more business in government," class interests assail Congress to protect them from the operation of natural laws that work for equivalence of the purchasing power of every man's dollar.

This is the condition precedent to recuperation from the stagnation and depression in which business throughout the country is mired.

Do you see any reason why in a period of deflation the profits of inflation should be conserved to any special interest, whether agricultural, manufacturing or that of organized labor, and the attainment of this condition precedent thereby deferred?

There is a super-government immune to the importunities of class whose basic law regulating prices the Congress will do well to recognize, and that is the law of supply and demand.

FROM \$3,000 to \$5,000 and at least four years, exclusive of the advancing requirements of admission to the higher institutions of technical training, are required to develop in a young man the potentialities of a chemist or of an executive in the chemical and allied industries.

Nowhere can be found such indifference and economic waste as are displayed in the "sale" of this high-class product.

In the multitude of organizations designed to consolidate and promote class interest, none exists to study, to standardize and to utilize with the utmost efficiency to industry, to the individual and to the institution that trains him, that pillar of modern industry called the Chemist.

Every chemically educated man imbued with the instinct of trusteeship owes to the New Jersey Chemical Society a debt of loyalty to give to its committee his well-reasoned opinion as to the prospective organiza-

tion and functions of the American Institute of Chemistry—to the end that the American Institute of Chemistry may be born of the needs and aspirations of chemists, and hence congenitally capable of growing to a maturity of service.

ORGANIZATION is the response to the cry for help. Hence it has its inception in human needs and develops as it fulfills them.

The virility of a professional society is expressed in its service to its members and is determined always by the foresight and loyalty only of an enterprising few who devote time and study to its interests. When these interests are limited to abstract pursuits or to intellectual exercises, the society functions simply as a mirror of specialized progress.

The growth of the American Association of Engineers in three years to a fully-graded and paid-up membership of over 23,000, with 4,000 applications unacted upon, with an active usefulness brought intimately home to each member and with no blatant camouflage of service to the people other than inheres in the reinforced capacity of its members, is an expression of the indifference of the older engineering societies to the economic welfare of the younger element of engineers.

THE dependence of the chemical and allied industries, in every department, upon chemically educated men for managerial positions will increase with the recognition of the necessity for men trained for industry.

The community of interest of these men demands organization on an economic plane and in a way that is not satisfied by any existing organization and for purposes broader, more intimate and more productive of results to industry and to men than are supplied by any existing organization.

Chemical education, though largely gratuitous, costs too much in tribute and the hazard of success to warrant, in this day of conservation of man-power, neglect of its subjects considered in connection with their potentialities as leaders of industry.

THE intimate inter-relations of our intensive civilization are reflected in the precipitate decline in values which has occurred in a period of months over against our only comparable experience of half a century ago which required years.

With plants shut down and on short time and distribution checked and general unemployment not yet at its maximum we approach the Adoration of the Master with reflections on the clumsiness of the works of man and the human selfishness which upsets His benign purpose.

CHEMICAL AGE greets its friends with an invocation to helpfulness, to that investment which pays the biggest dividends and to that consecration of effort which idealizes the hum-drum and the commonplace.

Organization and Construction of Dye Houses

By A. W. Benoit

Assistant Engineer with Chas. T. Smith, Boston, Mass.

THE purpose of a dye house is to apply and fix colors to textile materials of all kinds, although the scope of any one plant is usually limited to one or two kinds of materials. The purpose of this paper* is to discuss from the engineer's viewpoint the machinery organization, location, construction, ventilation and piping of dye houses. These topics are treated in more or less of a general way and certain fundamental principles are laid down which can be applied to individual cases according to the conditions which surround them.

The average dye house of the past was a damp, gloomy room, with murky windows, a series of shallow puddles, a confusion of trucks and machines, water dripping from the ceiling and pipes, and clouds of vapor rising from the kettles. Quite often the view consisted of one vast cloud of white vapor with a few shadows scattered through it. Fortunately that condition is fast disappearing and it is now realized that a dye house will function better, give greater production, with less damage to stock in process, if it is a well-lighted, well-ventilated room, free from steam, with reasonably dry floors and ceilings, and be a desirable place for a man to work in with reference to his health and mental condition.

This change has been brought about partly by statutory requirements, partly by demands of the employees for better working conditions, but largely by the advance in engineering practice and the closer co-operation of the engineer and the mill owner. There has been at the same time a revolution in dyeing processes, both as to methods and materials, which has simplified many of the problems.

The equipment mentioned later may not be complete in every detail since there is more or less special machinery used for special purposes and processes. There is considerable individuality shown by dyers in their methods and a wide variation exists in the methods employed to obtain similar results. As a rule the machinery used by all dye houses to dye raw stock, yarn and cloth is very much the same, but the method of handling and the process vary largely.

Kinds of Dye Houses

There are two distinct classes of dye houses, one being the converting plant which does dyeing and finishing for the trade; and the other, the plant dye house which dyes and finishes for the one mill only. The first generally covers a wider range and is prepared to do a great variety of work, while the latter is naturally of a narrower scope and is usually limited to dyeing the product of one plant. Converting plants are sometimes equipped to do bleaching and mercerizing, which add complications to their problems. For the purpose of this paper the dye-house problem will be discussed from the standpoint of the plant dye house.

The operation of dyeing enters largely into the four great branches of the textile industry, cotton, worsted, woolen and silk, and in many cases these lap over each other in the individual plants because of the great variety of combinations of stock used in making cloth. Cotton may be dyed in the raw stock, as yarn, or in the piece. Worsteds are dyed in the top, as yarn, or in the piece. The bulk of the woolen fabrics are dyed

in the stock, but yarn and piece dyeing are also common. Silk is generally dyed as yarn.

Machinery Organization

Following is a list of the kinds of machinery used in cotton, worsted and woolen dye houses. It will be noted that many of the machines appear in more than one of the lists. It must be borne in mind that most dye houses handle more than one kind of stock and in more than one form and will contain machines from more than one group.

COTTON-DYEING MACHINERY

FOR YARN: Boiling-out machines; doubling machines; chain dyeing machines; splitting machines; beam dyeing machines.

FOR PIECE GOODS: Jigs; continuous dyeing machines; padders.

FOR RAW STOCKS: Pressure kettles; rotary raw-stock kettles; hand tubs.

MISCELLANEOUS MACHINERY: Dye cans; mangles; washers.

WORSTED-DYEING MACHINERY

FOR YARN: Rotary skein-dyeing kettles; spool-dyeing kettles.

FOR PIECE GOODS: Piece-dye kettles.

FOR SLUB DYEING: Top-dyeing machines.

OTHER MACHINERY: Crabs; steamers; flat and string washers; extractors; carbonizing machines; dry cans; tentering dryers.

WOOLEN-DYEING MACHINERY

FOR YARN: Rotary skein dyeing kettles; spool-dyeing kettles; skein dyeing in machines in which the liquor is circulated.

FOR PIECE GOODS: Piece-dye kettles.

FOR RAW STOCK: Rotary raw-stock kettles; stock dyeing in machines in which the dye liquor is circulated; Dyed yarn

SILK-DYEING MACHINERY

FOR YARN: Rotary kettle for skeins; hand tubs.

This list might be added to for special work, but practically all dye houses have a machinery organization made up of a combination of machines from these lists. It will be noted that all of these machines with the exception of the dry cans and carbonizing machine are so-called wet machines, and steam is used in all of them with the exception of the extractors, doublers and splitters.

Processes

Of all dye houses, the one handling cotton only presents the fewest problems, due to the simple construction of the machines, the small amount of water and steam required, and the comparatively low temperatures at which the dye liquors are used.

Cotton Dye House. The cotton materials are delivered to the dye house as raw stock, as yarn in ball warps or beams, and as cloth in rolls. The machinery for this organization is given in the above list and requires no special description since it is quite common. In cotton dye houses the drying is usually done in the dye house proper, and for some classes of dyeing heat is required to develop the colors. Dry cans of various widths are used for this purpose, made up in both horizontal and vertical sets. Pits and trenches are required for many of these machines, but no so large an extent is in worsted or woolen dye houses.

Worsted Dye House. A dye house for worsteds is

* Presented at the Annual Meeting, New York, December, 1920, of the American Society of Mechanical Engineers.

somewhat complicated by the wet-finishing machinery required before and after piece dyeing and which should be so placed as to be convenient to the dyeing machinery. Considerable yarn dyeing is done either on skeins, in a rotary kettle, or on spools as in the Franklin process, but the bulk of the work is cloth, dyed in piece dye kettles.

Before dyeing the goods are crabbed, steamed, washed and sometimes carbonized. The machinery for these operations is usually in the dye house, but partitioned off from the kettle room. All this machinery requires water and steam in large quantities and calls for a building of somewhat the same construction as a dye house. The kettle rooms contain all the piece, yarn and top-dyeing kettles and the extractors or squeezers. The drying equipment consisting of dry cans and tenter frames should be conveniently located.

Woolen Dye House. In woolen mills the bulk of the stock dyed is scoured wool and noils, although there is more or less piece dyeing and a fair amount of yarn dyeing. The piece and yarn kettles are the same as used in a worsted plant. The only other machinery that should be in the kettle room of a woolen dye house is the extractor.

Much more might be said about the machinery used in a dye house, but it would consist largely of the description of machines which are well known. It might be said, however, that as a whole the machinery is exceedingly simple, but must be well built to resist the hard usage to which it is subjected by the use of steam, acid and water. It must be thoroughly reliable because of the damage which can be caused by a breakdown while stock is being dyed.

Location of Dye House

The location of the dye house in the plant is influenced by (1) sequence of operations, (2) water supply, (3) steam supply and (4) drainage. It is impossible to lay down any fixed rule as to the location of the dye house in a plant in its relation to other operations, because most dye houses handle the stock at more than one stage of the process. Each dye house becomes a problem in itself and its location must be decided upon by the particular conditions surrounding it and the purpose for which it is to be used.

If a dye house handles its product all in one form such as raw stock, yarn or cloth, its location is easily fixed, and if it handles stock in more than one form there is generally a preponderance of one kind which determines its location. In general, the position of a dye house for various kinds of plants would be as given below, from which it will be seen that the choice of location depends upon the form of the bulk of the product.

Kind of Plant	Product of Dye House	Location
Cotton	Dyed yarn	Near warping, dressing and slashing department.
Cotton	Piece goods	Near gray room and finishing department
Worsted	Yarn	Near warp preparing department.
Worsted	Piece goods	Near gray room and finishing department.
Woolen	Raw stock	Near scouring and picking department.
Woolen	Yarn (unusual)	Near dressing room.

A dye house requires an abundant supply of clean soft water. If this is available from a canal or river the dye house can often be advantageously located to secure its supply by gravity and thus avoid pumping. If the water is taken from a pond, it usually has to be

pumped and therefore the location of the supply has no influence on the location of the dye house. When the water is so hard as to require a softening plant, pumping is required and the same thing holds true with regard to location.

When the water supply is taken from a river that is polluted by sewage and waste from cities and mills upstream, it is sometimes necessary to install filter plants. This might have some bearing on the location of the dye house as well as its construction, since filter beds are sometimes placed in a part basement under the dye house.

A considerable portion of the steam used in a plant which has a finishing department is used in the dye house, either as live or exhaust steam for boiling liquor or for drying materials. While it is convenient and economical to locate the dye house near the power plant, it should not be a factor of any great importance. High and low-pressure steam can be transmitted through pipes properly proportioned and covered for a considerable distance with very little loss in heating value or pressure.

The waste water from a dye house often presents a problem which must be taken into consideration in locating the building. It particularly affects the height of the main floor, which must be such that the water in the trenches and cross-drains will run by gravity to the point of discharge into a river or sewer. This becomes further complicated by the fact that the future tendency is to compel manufacturers to treat the mill waste before discharging it into the rivers.

This part of the problem has a direct relation to the water supply when the latter is a gravity supply, and considerable care must be used in properly adjusting the levels. If the dye house is joined to another building from which it receives stock or to which it delivers stock, the same floor levels should be maintained if possible.

Dye-House Construction

Type of Building. Dye houses are built both single and multiple-story and are successfully operated either way. The multiple-story building is satisfactory if it is not too wide and the operations on the upper floors are not interfered with by ventilating ducts passing through the floors. The upper stories in such cases are generally used for the driers and storage of dyed stock. When the plant is cramped for space, a dye house of this kind is justified. But on the whole a one-story building is much better for both light and ventilation and is the type of dye house best fitted to give satisfactory results.

Size of Building. In determining the general dimensions of the building a machinery organization plan must be made of the equipment to be installed. The width of the bay is not essential and is usually about ten feet. The length of the span from column to column and column to wall should be about 25 feet, providing space for one row of kettles and an ample working alley.

The kettles should be installed in pairs, right and left hand, with the drives whether belt or motor-driven, outside, and an alley of 4 or 5 feet between ends of each pair of kettles. If there are but few kettles they can be economically arranged in two rows in the center of the room, the fronts facing the outer walls with a 12 to 16-foot working alley. The backs should be set 6 feet apart. If there are a large number of kettles they are best arranged in four rows, the two outer rows facing the walls with a 12 to 16-foot working alley, the two inner rows facing the center of the room

with a 16 to 20-foot working alley. The height of the room should be from 16 to 18 feet. at the eaves. If the building is three spans or more in width there should be a monitor in the middle to light the inner rows of kettles, as the window light is largely cut off by the machines and ventilators. (Fig. 1.)

Materials and Construction. The most satisfactory type of building for a dye house is that of slow-burning mill construction consisting of brick walls, wood roof and concrete foundations and trenches. The use of exposed steel is to be avoided in every way and for this reason wood sash is preferred to steel because of the corrosion due to moisture and acid fumes. An ordinary flat roof with a monitor, using hard-pine beams and 4-inch spruce plank, works out satisfactorily. The exact thickness of roof plank is necessary in cold climates for insulating purposes. Spruce or Douglas fir is preferable to hard pine as the latter contains resin which is softened by the heat and is likely to drop down upon goods waiting to be dyed.

All timber and plank used in the roof and the monitor should be kyanized after the framing has been done and before putting into place. This necessitates that much of it be done on the job. It is the best safeguard against decay and well worth the expense.

Sash.—It is desirable that dye houses located in cold climates should be equipped with double sash to prevent condensation. The extra sash is put in from the inside and can be made removable if desired. Double glazing is sometimes used to accomplish the same purpose and will be fairly effective if the space between the two lights of glass is about one-half inch.

Dyer's Office.—An office should be provided for the dyer, located on the north side of the room if possible, having a large window, preferably of plate glass, at which he can match sample of work taken from kettles for shade and color.

Chemical Storage and Treatment.—Space should be provided for the storage of dyestuffs and chemicals used in the dye house. This room should be near the dyer's office and partitioned off from the kettle room. It should be well lighted and have a steam and water supply to convert dry colors into liquid form before they are placed in the kettles.

Laboratory.—The modern and well-equipped dye house of today is provided with a laboratory where the dyestuffs and chemicals purchased may be tested and small samples of stock dyed. This should be located next to the dyer's office and connected to it.

Trenches.—Practically all types of dye kettles and washers are set so that much of the machine is below the floor level. In times past it was customary to cut a hole in the floor, which was 4 or 5 ft. above the ground, and set the machine on some wood bolsters or masonry piers. The waste was allowed to run out on the ground and find its way to an open drain. This sort of an arrangement made repairs very difficult and expensive and prevented the proper upkeep of the machines.

This is avoided now by building concrete trenches about 11 ft. wide by 6 in. deep, in which supports are provided for the machines, leaving a clear space underneath for the flow of the waste, and ample room all around to get at all parts requiring attention.

In large dye houses and also in those where, because of local ordinances, it is necessary to separate the hot waste dye liquor from the rinse water, an auxiliary drain should be provided in this trench. This is done by installing a separate drain pipe on one side or partitioning off part of the trench. The kettle is then provided with two waste pipes, one of which is connected to the closed drain and one opens into the trench. If the

hot liquor is run off into the open trench, it gives off clouds of steam which rise around all the machines. A main intercepting drain crosses the dye house, with which all the trenches are connected, and in some cases two such drains are provided to keep the wastes separate.

Floors. In a dye house of the above description the trenches are planked over after the machines are placed and all spaces between the trenches are back-filled and the floor laid directly on the ground. The floor consists of a concrete base with a top of either granolithic or paving brick, pitched to drain into the trenches. A granolithic top is only good in small dye houses where the trucking is light, because such floors crack more or less and break down at the edges under traffic, causing depressions which hold water and make trucking difficult. A granolithic floor that will stand up under heavy trucking can be laid by placing cast-iron grids on the concrete base and putting the granolithic finish over the grids and floating flush with the top. This floor is expensive but will stand a great deal of abuse. The best floor is obtained by using a vitrified paving brick bedded in cement mortar and well grouted. These brick should be not less than 2 inches thick and thoroughly vitrified. A common hard-burned brick will not answer the purpose.

Dye-House Ventilation

The subject of dye-house ventilation is a broad one and can hardly be covered within the scope of a paper of this kind; but it is most vital in the successful operation of a dye house and deserves a great deal of attention. This problem, so far as it applies to keeping the atmosphere clear of steam or vapor and the prevention of moisture from gathering on the ceiling and overhead structure and dripping to the floor below, is largely a matter of confining the steam at its source, discharging it outside of the building by the shortest possible route, and replacing the large volume of air which is carried out with steam, by warm, dry air.

The chief cause of obscurity in a dye house when kettles are boiling is not due to steam in suspension but to the dense fog caused by the precipitation of the moisture in the saturated air when it comes in contact with cold ceilings, floors, walls, pipes and cold air seeping into the room. Some of the hot vapor rising from the boiling kettles and tubs will condense on coming in contact with the overhead structure and the water will drip to the floor. That which is not expelled by fans or ventilators will cool off to the room temperature, creating a fog which settles toward the floor, gradually filling the whole room.

Many kinds of ventilating schemes have been used and are in use today, some of which are successful and others only partially so. The shape of the roof, the height of the story, and materials being handled are factors to be taken into consideration. For instance, a piece dye kettle is probably the worst machine to ventilate, while an enclosed kettle for dyeing spooled yarn requires no special ventilation. The other machines give off varying quantities of steam.

The simplest form of ventilation is to depend on the natural ventilation from the windows and monitor. In very small dye houses this gives fair results in summer, but in cold weather it is inadequate. It can be helped by a large heating system designed to keep the temperature of the air above the point where fog will form, or by putting the driers in the dye house, but at least it is unsatisfactory.

It is very often attempted to clear the air by using

exhaust fans in the monitor, and while this scheme will remove the hot, oppressive vapors, it does not clear the fog which lies in the lower half of the room. The air necessary to replace that driven out by the fans, comes in at the doors, windows or other inlets and as soon as the cold air comes in contact with the warmer saturated air a fog is produced which cannot be removed by fans.

Another scheme is to put large wooden hoods over the machines, singly or in pairs, with a vent from each hood going up through the roof and well above it. The idea is to catch the hot vapors before they are dispersed and by means of the natural draft due to the difference in temperatures, to get them out of the room. This works out fairly well and will give good results under normal conditions in medium-sized dye houses. There is still some fogging due to cold air in winter being drawn into the room to replace that carried out with the steam, but the humidity is much lower than with open kettles so that this is not so serious.

Where the attempt is made to remove the steam from the dye house by means of hoods and ventilators over the kettles, or with exhaust fans, or a combina-

tion of both, a partial vacuum is created in the room which causes cold air to be drawn into the room through cracks and crevices around doors and windows, through open doors and oftentimes down some of the ventilators over the kettles which is the cause of most of the fogging. This partial vacuum also retards the natural flow of steam and air from the ventilators.

The motor is furnished by a steel-plate fan taking its air through a sectional heater in which any desired number of sections can be heated depending on the temperature, and distributed about the room by a system of air ducts suspended close to the roof, having outlets delivering a blanket of warm air along the ceiling, eliminating all condensation from that source and having branch ducts dropping down to within 7 feet of the floor with outlets discharging towards the hoods and about the room. During the summer months the windows should be kept closed and the apparatus kept in operation but without steam on the heater. With the room clear of all condensation, vapor or steam, individual or group motor drive for the dye-house machinery may be used with safety.

The fan may be driven by either a motor or turbine.

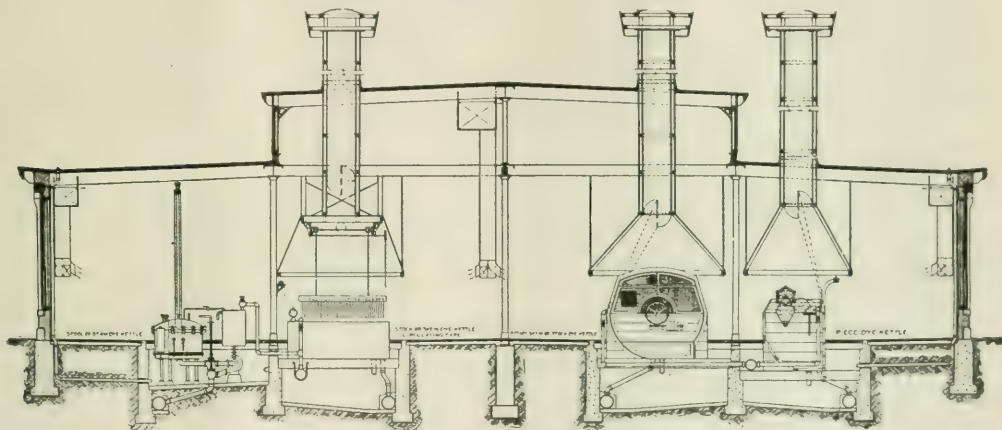


FIG. 1. CROSS-SECTION OF A TYPICAL DYE HOUSE

tion of both, a partial vacuum is created in the room which causes cold air to be drawn into the room through cracks and crevices around doors and windows, through open doors and oftentimes down some of the ventilators over the kettles which is the cause of most of the fogging. This partial vacuum also retards the natural flow of steam and air from the ventilators.

Some large dye houses have been ventilated without the use of hoods over the machines by means of warm air blown in along the ceiling and delivered in large quantities about 7 feet from the floor toward the machines. The steam, fog and surplus air escape through the monitor windows or ventilators in the roof. By this method the ceiling is kept dry and the fog is eliminated to a distance of about 6 feet from the floor. The shafting, piping and equipment in the upper part of the room are obscured by the fog which is moving upward.

The system of ventilation which has given the best results is to place over the kettles hoods having vents up through the roof and to distribute warm, dry air over the room and in a blanket on the under side of

The motor gives a constant speed while the steam turbine permits of a variation of speed which is desirable under intelligent supervision. The exhaust from the turbine is used in the heater in winter, and in the summer, or when any surplus exists, it is delivered into the low-pressure steam system and used in the dye house for boiling kettles or heating water.

Dye-House Piping

Each kettle has a hot-water, a cold-water and a steam connection, which means a good deal of piping to care for, and it should be laid out so as to be accessible and permit of changes. All cold-water piping must be below ground and is usually of cast iron run along the inside of the trench on the same supports as the machines. The high and low-pressure steam and hot-water piping are run overhead and covered.

Steam Supply. The objection to the use of low-pressure steam in dye houses for boiling kettles has about vanished, and where an ample supply of clean low-pressure steam is available, as from either bleeder or non-condensing turbines, a considerable economy can be effected. For worsted piece dyes this steam

must be free from oil, but in stock dyeing for woollens the exhaust from reciprocating engines can be used without injurious results if proper precautions are taken. If low-pressure steam instead of high is used at the kettles, the pipe sizes must be increased. Low-pressure systems have been condemned because of a failure to take this into consideration. A careful study should be made of the steam requirements of the dye house under consideration, especially with reference to peak loads, and the pipe sizes proportioned to meet these conditions. The piping should be ample to provide for the future growth of the dye house and the possible rearrangement and changing of machinery. It is difficult because of the varying load in a dye house to maintain an economical heat balance, but much can be done in the way of economy by careful arrange-

ment and the use of surplus steam to heat the water supply.

Warm-Water Supply. There should be provided, either close to the dye house or as part of it, an ample supply of warm water for washers, crabs, rinsing and such dye baths as can start with warm water. The simplest way to accomplish this is by means of wood storage tanks located high enough so that the water will flow by gravity to the machines. The water can be heated by exhaust steam or any other means. If there is a surface condenser in the power plant, the circulating water can be used and with a small sacrifice in vacuum can be delivered at about 120 deg. and pumped from the hot well to the tanks. The effect of this hot-water supply is to speed up the dye-house operations and reduce the peak load on the boilers.

Status of the Analytical Chemist

By Archibald Craig

Ledoux & Co., New York

THE pursuit of analytical chemistry, since it is associated with every industry, has its divisions comparable with those of industry in general. In our industrial system are found people at the bottom of the ladder performing the menial, unskilled but necessary work. There are skilled workers who make it possible for occupations be divided into specialties. Executive capacity creates a type of men who direct the work of the others and coordinate their efforts in a common purpose. There are the experts who apply scientific theory to the planning and operation of industrial processes and whose business it is to tell how work ought to be done. Lastly there are the distributors and financiers who handle the mechanism by which the products of labor are exchanged.

Types of Chemists

The occupations of the chemist are divided in the same way. There are still some chemists who do their work under the conditions of primitive society, making their own apparatus, carrying on their processes with their own hands and financing their own business, but most of us confine ourselves to a specialty to attain the proficiency demanded by the modern system. Some of us own laboratories and busy ourselves with finding work for other chemists to do. Some of us are in the position of experts, occupying ourselves with theory and letting others carry on the processes and provide the finances. Some of us in executive positions are occupied principally in getting other people to work and in keeping the industrial machine in shape by some kind of bookkeeping.

But by far the most of us are engaged in doing work of the same grade as that of the machinist or the draftsman or the cook. We are handling material things, persuading the atoms to readjust themselves, carrying on miniature manufacturing processes, either to enable someone else to make something, or to let him know what certain things are made of. It is as a member of the class of chemical artisans, the analysts, that I take up with you the conditions of their employment.

Enlistment and Promotion of the Analyst

The analytical force is recruited partly from the colleges, but most of them come in by way of the sink; not

through the drainpipe, of course, but beginning as washers of apparatus, general cleaners and grinders of samples. After they have been kept at these occupations as long as the boss thinks they will stay or perhaps by good fortune getting advantage of an early vacancy they are promoted to some routine operation such as weighing or filtering. Then they are able to show their aptitude for analytical work. Promotion comes by fits and starts as vacancies come for which the executive thinks they are fitted. If they have been studying and preparing themselves for advancement, promotion will be faster than if they depend on being instructed in each new operation, but sooner or later a time comes when there is no more advancement for them as analysts.

The next step will carry them into another class, requiring an entirely different kind of ability. No matter how well one may understand analysis, he must be able to do a very different kind of work if he is to take charge of a laboratory. He must be able to check the accuracy of other chemists, make them work, maintain discipline and in general practice the art of the executive. If his new position requires him to meet laymen, whether customers or heads of other departments, he must have at his tongue's end some theoretical knowledge which he may have learned years ago, but which he has not been able to use as an analyst. He must be able to talk and write about chemistry so that the laymen can understand him.

Very often the only promotion in sight for a works chemist is a position in charge of the operations in the plant; he must become an engineer.

The Beginner's Ambition

The beginner in an analytical laboratory early should decide whether he wishes to remain an analytical chemist in a subordinate position for the rest of his life, having a secure and sometimes healthful occupation of a humble sort and a salary about equal to that of a skilled mechanic, or whether he wishes to advance to an entirely different kind of job requiring an entirely different outfit of knowledge and ability.

Some may prefer the former course, as I have. It has its advantages. Given a well-equipped laboratory, reasonable freedom of invention in improving methods and apparatus and a considerate and trustworthy employer one may lead a peaceful and happy life as an

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analyst. One need not be physically strong or quick-witted or masterful. One has to contend only with material things and natural forces which can be mastered by study, care and experience without much regard to natural ability. There are endless problems to be solved, because all analytical methods are attempts to reach a conventional approximation to the truth with the least amount of work.

The circumvention of interfering elements requires continual changes in small details to keep up with changing requirements. The analyst who looks on his job as merely an introduction to an executive or consulting position naturally will be thinking of preparing himself for the new work; and for him pot-boiling will have a double meaning. Boiling chemical pots will serve to keep the kitchen pot boiling while he is acquiring or demonstrating ability to fill the new place. An employee is judged largely by past performances, and his record as an analyst may be a necessary means of introduction to the dispensers of the other kind of jobs.

The Natural Process a Spur to Individual Growth

The efficient executive in any industry is the one who can get the largest proportion of his work done by high-speed specialists with the least dependence on individual intelligence so that the labor cost may be low. While the analytical laboratory, through its necessary dependence on simple appliances and hand manipulation in processes which imitate those carried on by highly developed machines on the large scale, must use the brains of every worker to a greater extent than in mechanical pursuits, still there is a tendency to shift as large a part of the work as possible to rule-of-thumb men who need to know only the particular operation which they have been taught to carry out.

It should be the aim of every chemist not to be in this class, or to remain long in it. However necessary this grade of work may be for the profits of the business, the chemist who continues long in it will suffer for it both in his reputation and in his progress. A chemist who tries to do as much routine work as he can will be regarded as one of the lower order, who live and work for the benefit of the upper class. Not only will he suffer in his standing, but he will undergo a dulling of his mentality and will be less capable of further advancement.

Striving for a record for quantity invariably lowers the quality of the chemist's work. His reputation depends far more on its quality than on its quantity. As a matter of course, one should study how to shorten every operation which he performs; how to get it done with the fewest motions; but merely to speed up his hands and feet will cause him to be remembered mainly for broken glassware and mistakes. Those who have to get their introduction to chemistry by going through the lower grades can get some useful experience which they may use later in executive positions, but such experience is not worth what it costs. The chemist who treats his brains with respect, who insists on looking at his work from the point of view of the scientist rather than that of the mechanic, not only will fit himself for a job requiring more brain work and less hand work, but also will make a reputation which will insure promotion. It pays far better to be thought of as one who has the makings of the chemist than to be thought of as a fast routine man.

Economic Status of the Chemist

So much for the analyst as a pure individualist. If he expects to move on he may not care what conditions he leaves behind him, expecting to get his reward in a higher salaried position of another sort. But the chem-

ist who expects to spend a large part of his life in analytical work will need to think of making the laboratory a good place to work in and his pay check large enough to keep him in comfort.

The wages of beginners in chemistry have risen in the same degree as those of unskilled labor everywhere, but those of the more experienced chemists have risen very little, much less than have the expenses of their maintenances. In other occupations skilled workers have come much nearer to catching up with the increased cost of living. A carpenter can pick up his tools, go to another job and in a day demonstrate his fitness for it; and his fitness and his rate of pay may be taken for granted from the mere fact that he calls himself a carpenter.

When a chemist applies for another place his previous experience is only partly available as a qualification. The employer assumes that he will not be worth much for a month or more, and perhaps will not be satisfactory at all in spite of his previous good record. The result is that making a change, for an experienced analyst who has been promoted until he has reached the top salary in his place, generally means either taking a considerable risk or a lower salary to start with. For the beginner there is absolute freedom of contract, for he can go into some other work than chemistry if the pay does not suit him. Therefore, he gets the full advantage of the general rise in wages. But the longer he stays the more dependent he becomes on the good will of his employer and the less he is able to think of himself as a free contracting party.

The Chemical Societies' Indifference to the Material Problems of the Chemist

The chemist perhaps has thought of himself as a professional man or at any rate too closely related to his employer to engage in any conflict of wills over salary. Perhaps he has thought it beneath his dignity to cooperate with his fellow-workers in an attempt to obtain a common benefit. So teachers and actors and druggists have thought. They think so no more. They have tried association for their common good and have found it helpful and not degrading, but rather adding to their dignity and freedom. It may be worth while for chemists to consider whether they too may not cooperate for their common advantage.

The present chemical societies are dominated by successful chemists. That means in nearly every case men who are not analysts and whose economic interests are those of employers rather than of employees. It is not to the interest of the employer, or he seldom thinks it to be to his interest, to increase the wages of working people. A movement to better the condition of analysts, therefore, cannot look to the scientific societies for help. It must be done, if done at all, by an organization formed for that purpose.

Col. G. A. Burrell, co-inventor with George G. Oberfell of the Burrell-Oberfell charcoal absorption process for gasoline recovery, described in the September *CHEMICAL AGE*, reports that the following concerns, United Natural Gas Co., Oil City, Pa.; the B. B. Stroud Gasoline Co., Bradford, Pa.; the Oklahoma Natural Gas Co., Tulsa, Okla.; the United Fuel Gas Co., Charleston, W. Va.; the General Petroleum Co., Los Angeles, Cal.; the Johnston-Mathews Gasoline Co., Bradford, Pa.; the Cosden Refining Co., Tulsa, Okla., and the Louisiana-Monroe Carbon Co., Monroe, La., are either building or are about to build large scale charcoal plants after a thorough investigation by their engineers of the process.

Distillation as Applied to Coal and Lignite

By O. P. Hood

Chief Mechanical Engineer, U. S. Bureau of Mines

MUCH has been written on the subject of distillation of coal, covering the field from the intricate chemical reactions involved to the economic aspects having a bearing on statecraft. The subject is by no means new, since men of perception have for many years pointed out the fact that coal is a raw material from which many values other than the heat of direct combustion can be obtained.*

The growing appreciation of these values by the layman as a result of present writing is, however, new. There is a widespread feeling that we are not wise in our present methods of using coal. It is well to awaken general interest in this subject, and presenting the matter in exaggerated form to more quickly convey an impression is somewhat justifiable, but it is quite possible to overdo the matter.

When coal is used raw for heat generation it should always be with a proper understanding that this material might, under more favorable circumstances, be used for higher purposes. Beside major products of coke, gas and pitch, an alluring chain of oils, dyes and medicinals might have been produced.

Discrimination in the Utilization of Coal

While all this is possible it does not warrant the conclusion that all coal should be made to yield the last-mentioned products. Because wheat can be made into cake the market for bread is not to disappear.

There will always be much use for raw coal, for in this form the individual has the disposition of a maximum amount of energy with the least fixed liability. With raw coal in his own hands he is independent and can carry out his own will, while with the energy otherwise delivered he is dependent on a complex co-operative enterprise.

With the energy of coal transferred to gas or to electricity where we have maximum power and minimum bulk, the consumer must in some way assume his share of the upkeep of a vast distributing system not subject to his own disposition, and not readily reaching every locality. It must be recognized, therefore, that the distillation of coal is not for universal application, but that it will find its appropriate field of usefulness together with other and cruder methods.

Capital Requirements of Coal Processing

One is likely to overlook the fact that processing of coal to obtain more than one or two products is necessarily a large enterprise and not to be entered into with small means or on a limited scale. Even on a large scale the tendency has been to look to a single product to justify the installation; e. g., in the production of metallurgical coke the gas has been wasted, and in the production of city gas the disposal of coke was a problem.

While these conditions have changed, there remains a disinclination to enter into a business which depends upon marketing a chain of widely dissimilar products. Entrance into this business is therefore not easy, nor does it simply depend upon the possession of a source of raw material having favorable possibilities of higher distillates.

The investment required in large plants for coal processing is so great that it is no reproach to forego this

form of ultimate economy so long as our savings are more needed for development in other directions. In other words, conservation of capital is as necessary as conservation of raw material. One may regret that the clearing of western timbered fields did not coincide with the present demand for black walnut lumber, but at that time the cabinet wood was more worthily used as fence rails than as desk tops. The same principle may be applied to the present use of raw fuel.

Promising Fields for Coal Processing

There are, however, rapidly developing fields in which the processing of coal is extremely desirable and is practicable. These fields are made apparent by the greatly increased cost of coal, by a general realization that there is a limit to easily won high-grade coal, by the decline of natural-gas supply, the increased cost of transportation and a growing appreciation of and dependence upon fluid fuels, both gas and oil. A study of each of these factors brings one at some time in contact with processes involving coal distillation.

Economic Considerations

There is a popular hope that if elements of higher value are recovered from coal by distillation, the remaining fixed carbon can be sold at a price lower than the raw fuel; in other words, that coke as a domestic fuel can be sold at a cheap price.

Where in any process a chain of products is produced, the actual cost of production of each is largely a matter of bookkeeping and each is priced at what the market will bear. So far, the market has absorbed coke at a price which leaves little hope for cheap fuel from this source, and it is not likely that processed coal can yield cheap fuel. It is more likely to produce a fuel whose special qualities of cleanliness and smokelessness will command a good price and supplement our declining store of anthracite coal.

There is also the hope that by extensive distillation and other processes manufactured gas may reinforce our rapidly disappearing natural gas. There is little to justify the hope that relative prices for heat units in the form of gas ever again can be as low as they have been in the case of natural gas, for it is now recognized that even natural gas has been sold too cheaply to return the investment at the end of the producing period. The cost of transportation and distribution of gas is, in general, about equal to the cost of production, so that reduced manufacturing costs per thousand are not directly applicable to selling price.

The reduction in heating value for town gas is greatly to be desired in order to make available cheaper methods of gas manufacture, but the more bulky heat carrier will increase the distribution charges, so that altogether very cheap heat in the form of gas is not probable. In this field of industrial and city gas, coal distillation is to play an increasing part as gas-oil supplies decline, but it cannot be on a price level comparable with former prices of natural gas.

Distillation Processes

The fact that motor and other oils can be obtained from coal distillates and that there is a market for all that can be produced, strengthens the position of distillation processes. There is a growing appreciation of the fact that the character of coal distillates is quite as much a factor of the process as of the coal used. The amount

*Presented at the Annual Meeting, New York, December 7 to 10, 1920, of the American Society of Mechanical Engineers.

and quality of the distillates are determined by the heat experience of the primary complex constituents of the coal, so that variation in the engineering structure and mechanism of the apparatus, together with temperature treatment, gives opportunity for a variety of processes and results. These processes can, therefore, within limits, be fitted to the major products desired.

Low-Temperature Distillation and Cheap Fuel Prospects

A great deal of attention has been given to distillation resulting from temperatures not exceeding about 1400° F., which are lower than used in coke-oven or gas-retort distillation. Prof. S. W. Parr states that "In general, it is believed that all the products of decomposition have a higher intrinsic value as delivered under low-temperature conditions, chiefly because excessive secondary decompositions are avoided."

With the usual methods and lower temperatures there will be considerable difficulty in transmitting heat to coal at a sufficient rate to obtain reasonable capacities from a given investment and in this particular low-temperature distillation is at a great disadvantage, which must be equalized by a greater refinement of its products. It is therefore hard to see how low-temperature distillation can be expected to yield a cheap fuel.

Carbocoal Process

The most advanced experiment in this country using low-temperature carbonization and distillation is the carbocoal process, which produces a very fine fuel and a large yield of tar of special quality. The fuel, however, is a worthy competitor of anthracite rather than of soft coal, and certainly will not be a cheap fuel. In this process nearly double the quantity of liquid products is produced, showing the adaptability of distillation processes.

By-Product Coke-Oven Practice

Distillation of coal in by-product coke ovens is already the major process in the production of metallurgical coke, and in a few years probably only the peak load of productive years will be carried by beehive ovens. The gas produced is used in the adjacent industries which determine the location of the plant, and much of the tar is burned instead of fuel oil. An appreciable addition to the supply of motor fuels is made by the recovered benzol, and ammonium sulphate for fertilizer is recovered in quantity.

Distillation Processes in Gas Manufacture

A return to distillation methods in the city gas industry is indicated now that gas oil is no longer cheap for the enrichment of water gas and an outlet for coke in domestic heating service becomes more assured.

This is the most favorable field for the expansion of distillation processes. One of the most sensible fuel-conservation methods that can be fostered by the householder is to get the habit of burning coke. This should be obtainable in prepared sizes the same as anthracite, and in this form is finding favor in many markets.

Distillation of Lignite

There is great need for a high-class domestic fuel in the lignite areas of the United States where there are large supplies of low-grade fuel. The increased difficulties and cost of transportation of eastern coals into these districts makes the problem a specially urgent one.

Experimental work has shown the possibility of applying distillation methods to lignite, obtaining gas, tar, ammonium sulphate and a carbonized residue of excellent heating value. In most regions where this need exists the solid fuel would be the main objective of the

process, possibly wasting the others. The char is too fine for domestic use without briquetting, but when put in proper form it makes a fuel comparable with anthracite.

In the southern lignite area there is also a need of developing a distillation process which will make lignite available for the production of city gas. This seems quite possible from the indications of laboratory work, but in both of these fields there is no commercial development. It seems as though the laboratory and small-sized experimental plant had contributed about all that it could and the business awaits that longer step which must be taken to realize these results in full-sized apparatus. In fact, many fuel-distilling processes seem to have reached this interesting stage of expectancy.

A Virgin Field for Exploitation

C. M. Hughes, secretary of the Commercial Club of McMinnville and Warren County, Tennessee, writes to *Chemical Age* as follows:

"I want to avail myself of my relation as a subscriber to *CHEMICAL AGE* to tell my fellow readers, who might be interested in a technical professional way, of the natural resources of my neighborhood in Tennessee.

"McMinnville is a progressive town of 3,000 population and is the county seat of Warren County. It is on a branch line of the North Carolina and St. Louis Railroad, about 70 miles from Chattanooga, 60 miles from Nashville, and 40 miles from Murfreesboro. We have here coal, gas, oil and salt undeveloped and awaiting the touch of the technical man and the capitalist to yield profit for themselves and benefit to the community.

"I solicit the inquiry of any serious person, and shall be glad to go into details as regards the opportunities that exist here and to send samples of the natural products."

Calco Chemical Company

The sale of \$1,700,000 first mortgage 8 per cent. convertible gold bonds of the Calco Chemical Company, Bound Brook, N. J., with New York offices at 136 Liberty street, directs attention to an example of the remarkable growth of the American chemical industry in recent years, particularly as relates to dyestuffs manufacture.

The company was organized May 19, 1916, with the intention to manufacture only two intermediates, viz.: aniline oil and betanaphthol, but production activity rapidly extended to embrace eighteen intermediates and an equivalent number each of pharmaceuticals and finished dyes. Sales which have grown to an aggregate of over \$1,000,000 a month rank the organization as one of the largest manufacturers of the country in its special field. From the end of 1917 to the middle of 1919, the development of its business was hampered by engagement in war work.

The Bound Brook plant comprises fifty-seven buildings, the largest being 52 by 360, with a total space of 300,000 square feet, and valued at \$4,500,000. Three smaller plants are located at Jersey City, Woodbridge and Burlington, N. J. In March, 1918, control of the company was acquired by the Marsden, Orth & Hastings Corporation, 136 Liberty street, New York. The capitalization of the company is shown in the following table:

	Authorized	Outstanding
First Mtge. 8% Conv. gold bonds...	\$2,500,000	\$2,250,000
Preferred stock, 8% cum. (par \$100)	\$6,000,000	\$1,500,000
Common stock, without par value..	750,000 sh.	500,000 sh.

Low Temperature Carbonization of Coal

A Survey of Current German Developments and Practice

By Stewart J. Lloyd

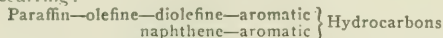
Professor of Chemical Engineering, University of Alabama

BY low-temperature carbonization of coal is understood its dry distillation at a temperature not exceeding 600 deg. C. (1,100 deg. F.). In ordinary by-product ovens and in gas retorts temperatures exceeding 1,000 deg. C. (1,800 deg. F.) are employed.*

The products of low-temperature carbonization are tar, semi-coke, gas and tar-water. The most important of these is the tar on account of the materials which may be obtained from it, but all of these products are radically different from the corresponding substances obtained in ordinary coking. They will be discussed individually in their proper places.

Low-Temperature Tar and Ordinary Tar Compared

Low-temperature tar, the primary object of the process, appears to be the original product obtained in the distillation of coal, while ordinary tar results from subjecting it to high temperatures and allowing the tar vapors to linger too long in an overheated atmosphere. The failure of ordinary ovens to produce low-temperature tar is due to the fact that coal is an exceedingly poor conductor of heat. The ordinary coke oven is built primarily to produce as much metallurgical coke in as short a time as possible. To do this it is necessary to put cold coal in an oven as hot as it can be made. The vapors of low-temperature tar arising from the interior of the coal, which is moderately heated, come in contact with the outer part of the coal and with the walls of the retort, both of which are over-heated, and are decomposed, forming ordinary tar, a change of the following type occurring:



The two conditions necessary to ensure production of low-temperature tar are a low temperature of distillation and rapid removal of tar vapors from the heated apparatus.

Low-Temperature Carbonization on a Small Scale

The necessity of providing against local overheating of the coal led naturally to the use of a revolving drum heated externally by gas. This makes it unnecessary for the heat to pass through the whole mass of the coal to reach the interior, thereby overheating the outer part; the rotation of the drum which is never more than one-third filled constantly presents new surfaces of coal to the heating surface. The other condition for low-temperature tar production is also satis-

fied, in that the tar vapors on their way out pass through the free space in the drum instead of through the hot coal.

To separate all the tar it has been found necessary to centrifuge the gas or to subject it to something like the Theisen washer. Working in this way quantities of coal up to 15 kg. have been carbonized, including lean, fat, gas coals, cannels, and lignites. The following general observations have been made in numerous experiments with this apparatus.

Carbonization practically always begins at 450 deg. and is completed at 575-600 deg. C. Tar water in amount equal to the tar is given off, and gas to the amount of one-half to one-third cubic meters per 10 kg. of coal. The first tar coming off is lighter than water; the latter subsides. If the coal contains appreciable quantities of low-boiling hydrocarbons already formed in it, it is quite possible, by judicious heating, to drive them out and separate them. This has been done for certain coals from Minden.

The construction of the revolving drum as used by Fischer and the author provides also for the passage of steam over and through the coal. This is to carry out the heavy tar vapors before they have time to decompose. The yield of tar is always higher when steam is used and the specific gravity is higher, showing that some decomposition has been avoided.

Possible Use of Drum Apparatus on Large Scale

Plans have been made and designs drawn for the construction of this drum apparatus on a scale large enough to handle several tons of coal at once, but war conditions have hindered their realization. There is no reason however why difficulty should be met in constructing and operating these. An installation of this kind in which tar is the main product would be something new in the coal distillation industry. Coke ovens have metallurgical coke as their main product; gas retorts and producers are operated to generate gas, while tar has been in general regarded as a nuisance. The industrial possibilities of such a plant however are at present difficult to estimate as they inseparably are bound up with the utilization of the other products, semi-coke, gas and tar water. The gas has a very high heating value and no difficulty would be encountered in finding a market for it, apart from its use in heating the drums. The tar water is probably valueless as its ammonia content is very small. The crucial point is the utilization of the semi-coke. Even assuming that it has no value the case is no worse than that of the distillation of the bituminous schists (oil shales) which is locally profitable. Indeed successful attempts have been made to distill the bituminous "slate" from the coal mines. More will be said later about the value of the semi-coke.

Large Scale Production of Low-Temperature Tar in Producers

The ordinary producer is primarily a shaft oven into which cold coal is dropped from above, gradually passes downward and at last burns at the bottom. Naturally the temperature in the interior of the coal

*Peer, of the University of Illinois, has been a pioneer in low-temperature work in America. Wheeler and Horvath, among others, have led the way in England. In Germany, both during the war and after its close, the Kaiser Wilhelm Institute for Coal Study at Mulheim-Ruhr has carried on numerous researches in this field, most of them at the hands of Franz Fischer and W. Glaud. The results of all this work on the conditions have been published in the *Gesamte Abhandlungen zur Kenntnis der Kohle* (Gebr. Borntraeger, Berlin), but are scattered in many papers on other phases of the coal problem. Recently (1919) this same material has been brought together and worked over by Glaud to form a monograph of seventy pages (*Die Tieftemperaturverkohlung der Steinkohle*), which contains all the substance but lacks the experimental details of the original papers. This book is the only one, to the writer's knowledge, yet printed on the subject, except perhaps Bulletin 60 of the University of Illinois, and as it may not be very accessible to American readers an abstract of it is given in this article.

risers steadily as it descends. When a temperature of 450 deg. C. is attained distillation begins with evolution of tar vapors and gas. In most producers however conditions are such that the gas arising from the partial combustion of the coal at the bottom rises through the coal and carries off with it the products of distillation. This gas has a very high temperature at least 800 deg. C., and the distillation products are hence brought to that temperature. Decomposition results, just as in the ordinary coke oven, and the resulting tar is not low-temperature tar. Moreover the dilution of the distillation gases with the products of partial combustion in the producer makes the problem of recovering the tar a very difficult one.

To remedy these defects and hence to produce low-temperature tar in producers two different means have been employed. The first consists in fitting the producers with tubes running lengthwise through which the coal passes downwards instead of through the body of the producer proper. In this way the products of distillation are kept entirely separate from those of partial combustion and the hot gases of the latter do not pass up *through* the down-traveling coal, but *around* it, on the outside of the tubes. Thus the temperature of the distillation products does not rise above their decomposition point; in addition the distillation gases *only* need be handled to insure separation of the tar, while the producer gas proper can be taken from the producer at any temperature desired. In actual practice with these modified producers it has been found necessary to suck up some of the producer gas through the tubes to keep the temperature up to a sufficient point.

The other means is to run the producer at a much lower temperature, attaining this result by a liberal use of steam. This is essentially the Mond producer and its main object is a large ammonia yield. In such a case there is, it is true, little danger of overheating the tar vapors and decomposing them, but the difficulty of separating the tar from the tremendous volume of the combustion gases still remains. One kg. of coal furnishes 50 litres of distillation gases, but also 3,500 litres of combustion gases. The Mond producer therefore has to separate its tar from seventy times as much gas as the other type.

So far over one hundred of these producers with tubes are in operation or in course of construction. Quite a number of Mond producers have succeeded also in making low-temperature tar. The objection that the removal of the tar would lessen the value of the producer gas for metallurgical work, by lowering its heating value, has been shown to be unfounded as the simultaneous removal of water more than compensates for this.

In practice gas coals, those containing 30-40 per cent. volatile matter, have proven most useful. Such a coal, in the revolving drum, gives about 8-12 per cent. of its weight in tar, and the results obtained with tube-producers approximate this same figure. There are in Germany all told some 4,000 producers, 2,000 of which use bituminous coal. If all these were converted into the tube type, or operated as Mond producers, it would be possible to produce some 400,000 tons of low-temperature tar per year. In certain cases indeed a mixture of lignite and bituminous coal has proved effective.

Cannel coal, of course, is by far the best if obtainable, but deposits are very rare in Germany. Lean coals and anthracite are naturally of no value at all. Certain coals soften very readily when heated and

move along the tubes of the converter with great difficulty. It is much preferable to use coal which does not soften in this way, but preserves its original structure. Certain coals from Upper Silesia are very valuable for this reason, giving incidentally 9-12 per cent. of tar. Similar coals are also found in the Ruhr district. Indeed, Germany is well provided with coal entirely suitable for this purpose.

Products of Low-Temperature Carbonization. Tar

Low-temperature tar is the primary product of coal distillation; ordinary tar results from its decomposition. The following differences between them may be noted:

Ordinary Tar.	Low-Temperature Tar.
Black.	Dark brown, golden red in thin layers.
Smells like naphthalene.	Smells like hydrogen sulphide.
Sp. G.: 1.1.	Sp. G.: .95-1.06.
Contains benzol, naphthalene and anthracene.	A mixture of hydrocarbons and phenolic bodies. Paraffins, olefines, naphthenes, hydroaromatic, and methylated aromatic hydrocarbons.
High in free carbon.	Little or no free carbon.

The presence of naphthalene in a tar excludes it from the class of low-temperature tars. As a rule the higher the percentage of tar from a coal the higher the phenol content, but cannel coals constitute a notable exception to this, yielding from 15-30 per cent. of tar, which is very poor in phenols, but rich in paraffins.

The presence of such large amounts of phenolic bodies is what differentiates low-temperature tar from natural petroleum. Petroleum does of course contain phenolic bodies, but never in amounts approaching 50 per cent. This tar otherwise is very similar to Russian petroleum. It is upon the utilization of these phenols that the value of low-temperature tar ultimately will depend. So far no uses of magnitude sufficient to absorb the tremendous amount of phenols available have been discovered.

Uses for the Tar

Fuel—For this purpose we require a high heating value and a low viscosity as the tar in many cases will have to flow through pipes. An average heating value for the tar proved to be 9,000 cal. The viscosity varies widely, depending upon the content of paraffin. One technical tar gave a viscosity of 49 Engler units at 20 deg. C., while several made in the revolving drum apparatus showed from 9-55 E. The safest procedure is to remove the paraffin, not a difficult matter, and sell it separately, as it brings a good price. As a matter of fact the price of low-temperature tar so far has been too high to permit of its use as a fuel.

Lubricant—The ready oxidation of the phenolic constituents is likely to cause trouble here, but practical tests have shown that only in places to which access is not easy and which consequently cannot readily be cleaned is this troublesome. It is probable that two grades of lubricant will be produced from the tar in the future: one suitable for all purposes, with the phenols removed; and the other the raw tar which naturally can be sold at a lower price. Even so it is much superior to many of the lubricants generally used throughout the war.

Paint—Here its property of thickening in the air

through the oxidation of its phenols is of positive value, as linseed oil is very scarce at present. Alone it gives a soft brown color, but this color may be modified by mixing with its various oxides. It has been tried so far on both wood and iron, and after two years' exposure is still good.

Constituents of Low-Temperature Tar

The constituents are mainly hydrocarbons and phenolic bodies with subordinate sulphur and nitrogen compounds. The following description relates to a tar of the following composition: C., 83.06%; H., 9.13% N., 1.00%. After separating the phenols by caustic soda, the residue was distilled. From 20° to 300° C., ordinary distillation was followed; from 300° on, vacuum or super-heated steam distillation, or both.

Between 20°-60° C. substances analyzing C. 83.1% and H. 16.6% were obtained, evidently paraffin hydrocarbons, close to hexane and pentane. Between 60° and 100° analyses showed C., 85.02% and H., 14.84%. This probably was a mixture of paraffin hydrocarbons and naphthenes. In most samples no benzol could be detected, but in one tar from a Minden coal a trace was found. Between 100°-125° C. the analysis showed C., 86.68% and H. 13.12%. No toluol was found here, though this is the fraction in which it would have appeared if present. From 125°-190° C. analyses showed C., 86.8% and H., 13.18%. The sum total of this distillate going over between 20-200° C. is essentially benzine or petroleum ether, a stable liquid of pleasant odor. The heat of combustion came out as 11,000 cal.

Over 300° C. when vacuum and superheated steam distillation is employed we obtain solid paraffins and viscous lubricating oils, the tar distilling entirely without residue. The solid paraffins have been examined carefully and are the straight-chain hydrocarbons, especially those between $C_{20}H_{40}$ and $C_{25}H_{50}$. Summing up, the paraffin hydrocarbons constitute 10% of the tar; benzol may be present in traces, but toluol, naphthalene and anthracene are entirely wanting.

The phenolic constituents are separated readily from the tar by shaking with a 10-20% caustic soda solution. Acidifying the aqueous solution separates the phenols as a dark layer heavier than water, but lighter than salt solution. When these are distilled, the thermometer rises steadily from 180° to 300° C. Clear yellow oils come over, which darken in light and air. No carbolic acid at first could be detected in any of them, but more sensitive methods of analysis indicated the presence of 0.06% in one case. Cresols, mostly meta, to the extent of 1-2% were found. The xylois likewise were detected along with pyrocatechin.

In the comparison of low-temperature tar from gas coal with that from lignite, it is found that both have essentially the same constituents, but in different proportions. Lignite tars are relatively low in phenol and high in paraffin, carrying only half the phenol of the gas-coal tars.

Working Up Low-Temperature Tar—Distillation with Superheated Steam

With 100° C. steam the light-boiling benzine exclusively comes over first and the distillation then comes to a stop. Upon sending through superheated steam the higher hydrocarbons come over up to 180°-200° C. and with them about the same amount of phenol. Above 200° C. viscous oils appear, and naturally the higher the temperature the greater the viscosity. The specific gravity of the distillate now begins to surpass that of

water, and paraffin separates out. Finally the distillate consists of a thread-like semi-solid substance brick-red in color. No residue is left in the distilling flask.

If it be desired to use these viscous distillates as lubricants their viscosity and flash point become at once of interest. Fractional condensation as carried out in petroleum refining, with receptacles maintained at different temperatures, affords a means of holding up the flash point by keeping out the low-boiling portions. The resulting oil contains of course about 50% of phenol, as well as paraffin. The latter must be removed in order to keep the oil liquid in cold weather as well as to recover its own value. This presents no difficulties as a similar problem has been encountered for decades in petroleum refining.

After removal of the paraffin the next problem is the removal of phenols. If done, it means the loss of half the material and the lowering of the viscosity, as the phenols are considerably more viscous than the hydrocarbons, which boil at the same temperature. For most purposes it is really unnecessary to separate the phenols at all, as the only two objections to them are not serious, viz., that their acid properties will enable them to attack metallic parts like axles, and that their ready oxidation in air will produce gummy asphalt-like masses. The effect of phenols on metal actually is very slight at ordinary temperatures, and for use in open, easily cleaned places the thickening is not particularly objectionable.

For certain purposes, however, such as use in steam-engine cylinders we want really first-class lubricants, and must therefore remove the phenols. Lubricating oils of this kind were obtained at the Institute with a viscosity of 2 Engler at 99° C., and 30 Engler at 50° C. and a flash point of 200° C. These products were clear gold-red oils showing green fluorescence.

There is no question therefore of the possibility of obtaining fire-class lubricants from low-temperature tar. As was previously noted it is very likely that two grades of lubricant will be on the market from this source; one with the phenols still present and sold at a low price; the other with the phenols removed and bringing a higher price.

Between 15-35% of the total weight of the low-temperature tar may be used for lubricating purposes. Assuming a yearly output of 300,000-500,000 tons of tar we may therefore count upon 100,000 tons of lubricants (in Germany).

The paraffin which may be recovered from the tar constitutes about 1-1½% of the weight of the latter. It has a M. P. between 50-60° C. There is here then a source of paraffin to the extent of 5000 tons per year.

The last product is the red resin. Numerous uses have been suggested for it, e. g., to dissolve it in less viscous oils for lubricating purposes, or to use it as a varnish after solution in benzol.

Working Up Tar by Direct Distillation

Up to 300° C. there is little difference between direct distillation and that by superheated steam; none at all up to 200° C. Between 200° and 300°, however, the yield of products is somewhat greater in direct distillation, as the viscous oils going over with steam above 300° are broken up and come over below in direct heating.

Up to 150° C., therefore, we have benzine, light and heavy, coming over. The distillate between 150° and 300° may be freed from phenol, or not. If it is freed the question arises, what shall be done with the phenol

produced. There are of course certain uses for considerable amounts of phenol but it is a question if industry can absorb at present the tremendous amounts which would be set free in this way. Moreover the remaining paraffins would be made more expensive by the cost of separating them from the phenols, so that altogether it would appear wise to avoid this separation and use the two together. This naturally limits the possible uses of the product and suggests its use as a motor oil. Its low flash point would, however, suggest the advisability of separating the fraction up to 225° and using it as "Zündöl." The remainder would serve excellently as motor spirit. The heating value of this is about 8,600 cal., with a setting point of -7. It fulfills therefore the usual requisites for a motor fuel. The amount of such fuel which may be obtained is about 24% of the low-temperature tar.

The products distilling over above 300° C. consist of a viscous oil containing the greater part of the paraffin, and a residue of coke or pitch. The viscous oils coming over between 300°-325° C. consist of lubricating oils containing phenol, which may be used as such after the paraffin is removed. The yield of such oils is comparatively small, about 24% of the tar. If it is desired to obtain a high-grade lubricating oil from this portion, the mere removal of the phenols will not suffice, as they carry with them, so to speak, the viscosity. To restore the latter the remaining hydrocarbons must be heated for some time at 360° C., which brings the viscosity to 30 E. at 50° C.

The last product of distillation is of course the pitch or coke amounting to 10% of the tar. This contains little free carbon, and has been used for divers purposes.

The following table gives the chief products in both types of distillation, with the average amounts.

With Superheated Steam.	Direct Heating.
Benzine, to 150° C. 10%	Benzine, etc., to 225° C. 28%
Phenolic motor oil 30%	Motor spirits, etc., to 300° C. 24%
Phenolic lub. oil 35%	Viscous phenolic oils with paraffin 24%
Phenol-free lubricants. 15%	Pitch 24%
Paraffin 1-2%	
Resin 23%	

Remaining Products of Low-Temperature Carbonization. Semi-Coke

Most of the low-temperature carbonization in Germany so far has been carried out in the producer, where of course the semi-coke is burned, but if the revolving drum apparatus ever becomes of practical importance the disposal of the solid residue will require attention. This solid residue varies according to the coal used. Gas coal produces in the drum spherical, slightly softened particles which easily break up and crumble. High ash coals which do not soften are reduced to a powder. Other coals retain their original shape very well, especially some from Upper Silesia. Occasionally a coal is encountered which carbonizes to a foamy mass, filling the whole drum.

Semi-Coke burns without smoke, is much more easily ignited than ordinary coke, and likewise has a longer flame. Its chief disadvantage is its brittleness and inclination to crumble; only in case of coals which preserve their original form and solidity would it be possible to use the product directly as fuel. Such coals, which give also a good tar-yield, are found abundantly in Upper Silesia and in the Ruhr, but are absent in the Saar valley. Of course the friable crumbly coke may be briquetted, but this involves the abandonment of its smokelessness. Considerable success

has been attained also in using it in place of pulverized coal.

The following three analyses serve to indicate the differences between coal, semi-coke, and ordinary coke.

	Volatile Const'n's	Solid Residue	%C.	%H.	%O.	%N.	%S.
Coal	39.7	60.3	82.2	5.2	8.7	2.1	1.8
Semi-coke ...	17.5	82.5	84.9	3.9	7.5	1.9	1.8
Coke	2.1	97.9	96.6	.4	1.6	..	1.37

The heating value of semi-coke, reckoned with ash-free coal, runs about 8,000 calories.

Gas

Study of the gas produced by low-temperature coking has been limited at the Institute to gas produced in the drum apparatus. Its heating value is 8500-9000 cal., after the benzene has been removed from it by compression and washing. On the other hand while 1 kilo of coal produces by low-temperature carbonization about 50-75 litres of gas, ordinary coke ovens and gas retorts produce from four to seven times as much.

Tar Water

A volume of tar water approximately equal to that of the tar is obtained from most coals. At present it can hardly be looked upon as of value, though no exhaustive study of it has been made. It contains ammonia, pyrocatechin and hydrogen sulphide, none of them, however, in economic quantities.

It should be pointed out that the low yield of ammonia is one of the disadvantages of low-temperature carbonization; 70% of the original nitrogen remains in the semi-coke, and only 2% is converted into ammonia.

Conclusions

From what has been set forth here no doubt can remain that low-temperature coking can furnish us with the needed amounts of liquid fuel as well as benzene, lubricants, paraffin, etc., hitherto obtained only from petroleum. It is hard to say just what progress has been made in this field in England and America. In Germany the firm of Ehrhardt & Selmer, in Saarbrücken, has succeeded in overcoming fully the initial difficulties connected with the use of producers fitted with tubes, so that large quantities of the tar are actually being produced. Producers of the Mond type are made by Thyssen (Mulheim, Ruhr), recovering also the ammonia content. By merely rebuilding producers already in use it is easily possible to turn out half a million tons per year of the tar in a short time;

It should be emphasized that the production of this tar will not deprive other industries of their raw material. By-product coke ovens operate mostly with "fat" coal, which is not desirable for low-temperature work. The gas lighting industry likewise will be undisturbed. Hitherto low-temperature tar has been made but not separated in the producers, being burnt along with the solid matter of the coal. It is quite possible, too, that in time the semi-coke may come to be the main product as an ideal domestic fuel.

Courtauld's, Ltd., artificial silk manufacturers, with main plant at Coventry, England, and American branch in the Viscose Co., with plants at Marcus Hook, Pa., and Roanoke, Va., has placed a valuation of £7,806,086 on its American assets.

In addition to a stock dividend of 100 per cent. to the stockholders of the present company, distributed in December, 1919, the value of the American assets will be capitalized by the distribution to stockholders of two fully paid shares in Courtauld's, Ltd. Stock in the company £1 par, is now worth £7.10s.

Personal Items

B. J. Corson, formerly chief chemist of the Durkee Atwood Co., Minneapolis, Minn., is now engaged in research with Hemmingway & Co., Bound Brook, N. J.

* * *

Lloyd A. Hall, formerly chief chemist, John Morrell & Co., packers, Ottumwa, Ia., is now with the Boyer Chemical Laboratory Co., Chicago, Ill.

* * *

W. W. Peters, formerly chemist with Dow & Smith, consulting chemists of New York City, is now assistant chief chemist of the Beacon Oil Co., Everett, Mass.

* * *

H. B. Corbett, formerly biologist with the U. S. Public Health Service, is now with the Herman A. Metz Laboratories, Inc., 122 Hudson St., New York.

* * *

Harold N. Hermann, formerly chemist with the Efflorose Sugar Co., Carthage, Ohio, is now with the Mantius Engineering Co., Inc., 15 East 40th St., New York.

* * *

Lauren H. Ashe, formerly production manager, Capitol City Products Co., Columbus, Ohio, is now assistant general manager of the Ko-Ko-Mar Co., Cleveland, Ohio.

* * *

Thos. E. Comerford, formerly chemist at the Fayetteville, Ill., plant of the Aetna Explosives Co., is now with the Oldbury Electro-Chemical Co., Niagara Falls, N. Y.

* * *

Chas. L. Wiswall, formerly production manager, Vulcan Detinning Co., Sewaren, N. J., is now chemical engineer with the Perth Amboy Chemical Works, Perth Amboy, N. J.

* * *

Dr. Ellwood B. Spear, until recently associate professor of inorganic chemistry, Massachusetts Institute of Technology, is now with the Goodyear Tire & Rubber Co., Akron, Ohio.

* * *

L. E. Jackson, chemist with the Empire Gas & Fuel Co., Bartlesville, Okla., has been awarded a fellowship at the Mellon Institute of Industrial Research of the University of Pittsburgh.

* * *

Lewis W. Armstrong, formerly chemist of the Wisconsin Chemical Products Co., Shawano, Wis., is now in charge of the laboratories of the Kimberly-Clark Co., Niagara Falls, N. Y.

* * *

Richard H. Catlett has resigned his position of production manager of the Taylor Chemical Co., Penn Yan, N. Y., and is now chemical engineer with the Lewis Recovery Corp., of Boston.

* * *

N. C. Perini, recently assistant factory superintendent of the Standard Chemical Co., Des Moines, Ia., has joined the instructing staff of the chemical department of the University of Minnesota.

* * *

Ralph B. Hammond, formerly research chemist, Mohr Chemical Works, Inc., Niagara Falls, N. Y., is now division superintendent of the Niagara Falls plant of the Adheson Graphite Co.

* * *

Dr. M. O. Teague, formerly gas chemist at the Pittsburgh Station of the Bureau of Mines, is now

research chemist with the United States Rubber Co., 561 West Fifty-eighth street, New York.

* * *

Robert J. McKay, superintendent of the research department of the International Nickel Co., of Bayonne, N. J., is now Industrial Fellow at Mellon Institute of Industrial Research, Pittsburgh, Pa.

* * *

Hudson H. Bubar has resigned from the National Aniline & Chemical Company, Inc., to accept a position as maintenance and construction engineer with the Mutual Chemical Company of America, 55 John St., New York.

* * *

R. E. Dammon, of the Stauffer Chemical Co., San Francisco, Cal., will be local manager of the Freeport, Texas, plant recently acquired by his company from Freeport Chemical Co. The product is refined sulphur in various forms.

* * *

A. J. Wendler, formerly an instructor in chemical engineering, University of Michigan, is a recent accession to the staff of the test division, engineering department of the Buffalo, N. Y., plant of the National Aniline & Chemical Co.

* * *

C. H. Kidwell, formerly of the Water Resources Branch of the Geological Survey, succeeds W. N. Henderson as chemist in coke oven operation with the Smet Solvay Co., Syracuse, N. Y. Mr. Henderson goes in the engineering department.

* * *

R. B. Arnold, formerly with the Kentucky Tobacco Products Co., and latterly engaged in consulting chemical engineering practice at Richmond, Va., is now vice-president in charge of manufacture of the Delion Tire & Rubber Co., Baltimore, Md.

* * *

Richard Sheldrick, after 15 years' service with the Kalbfleisch Corp., 31 Union Sq., N. Y., has resigned as secretary-director and sales manager. Mr. Sheldrick is now associated with D. A. Himadi & Co., Inc., 51 Maiden Lane, in the capacity of vice-president.

* * *

M. J. Brady, Ralph Black and A. H. Beitcher, all recently of the sales staff of the Butterworth-Jackson Corp., 61 Broadway, New York, are now connected, respectively, with the National Oil and Supply Co., Standard Color and Chemical Co., and the Vulcan Color and Chemical Co., of New York.

* * *

Col. G. A. Burrell has resigned his position as president of the Island Refining Corporation to take charge of refinery construction for the France-Canada Shipping Corporation, 120 Broadway, New York City. He sailed for England on October 23d, to be gone three months in the interests of the latter company.

* * *

Recent accessions to the staff of the Newport Co.'s, Carrollville, Wis., laboratory, described in September CHEMICAL AGE, embrace De Witt O. Jones, who has been in charge of the research laboratory of the Armour Fertilizer Works, Chicago, Ill.; Arthur Bridge, for the past eight years chemist for the Central of Georgia R. R., at Savannah, Ga., and Max Albert, formerly in charge of the branch chemical laboratory of the Bureau of Standards at Northampton, Pa.

Industrial Notes

The General Chemical Company is erecting additions to its plant at Garfield Heights, Ohio.

* * *

The Magnetic Pigment Co., 81 Fulton Street, New York, has increased its capital from \$30,000 to \$100,000.

* * *

Ben H. Case, mining engineer, Asheville, N. C., has reorganized the Carolina Feldspar Co., capital \$250,000, to develop local feldspar deposits.

* * *

The Ault & Wiborg Co., Cincinnati, Ohio, manufacturer of dyes, will build a brick and reinforced concrete factory on Dana Avenue, Evanston, to cost \$110,000.

* * *

The D. & B. Co., Inc., capital \$100,000, has been organized by John L. Dabbs, H. G. Mayor and B. C. Nalle, of Charlotte, N. C., to manufacture textile sizing compounds.

* * *

The Tennessee Paper Mills, Chattanooga, Tenn., A. M. Shepherd, vice-president and general manager, plans to install an additional unit costing \$750,000 for boxboard manufacture.

* * *

Paul O. Abbe, Inc., 30 Broad Street, New York, manufacturer of grinding machinery, is having plans prepared for the erection of a one-story addition to its plant at Little Falls, N. J., to cost \$15,000.

* * *

The Libbey-Owens Co., Toledo, Ohio, will build a new glass manufacturing plant at Toronto, Canada, which will be operated by an independent organization to be known as the Canadian Libbey Co.

* * *

The Palestine Salt & Coal Co., Palestine, Texas, by recent improvements costing \$100,000, has increased its daily salt production to 100 tons. The salt is obtained from wells drilled to an average depth of 100 feet.

* * *

The Rumford Chemical Works, Providence, R. I., is planning the erection of a three-story building costing \$100,000 as an addition to its plant at East St. Louis, Mo., recently acquired from the Layton Pure Food Co.

* * *

The Lindsay Light Co., 461 East Grand Avenue, Chicago, has received preliminary bids through Ernest A. Mayo, architect, 53 West Jackson Boulevard, on a one-story and mezzanine floor plant, 250 x 450 ft., to cost \$950,000.

* * *

The Baltimore Pearl Hominy Co., Baltimore, Md., manufacturers of cereal sugar, will install additional equipment to increase its daily capacity to 100 barrels. A new 3-story, 60 x 250 ft., structure is contemplated for 300 bbl. daily capacity.

* * *

Marden, Orth & Hastings Company, 136 Liberty St., New York, have been appointed exclusive selling agents for the Electro Company of Peoria, Ill., who will produce refined corn, cottonseed and soya bean oils, and hardened vegetable oils.

* * *

The shut-down of the Memphis, Tenn., plant of the

Buckeye Cotton Oil Co., a Procter & Gamble subsidiary, throwing about 500 men out of work, reflects prevailing conditions in the cotton oil industry arising from lack of demand for oil and meal.

* * *

Sales of the Sherwin-Williams Co., Cleveland, Ohio, for the fiscal year ending Aug. 31, 1920, totaled \$75,952,000, which represents a gain for the entire company of \$22,000,000 over 1919. Sales for the American companies alone were \$51,817,000, compared with \$36,992,000 in 1919.

* * *

The Hercules Oil Products Corporation, affiliated with the Hercules Powder Co., Chula Vista, near San Diego, Cal., has awarded contract to the Winter Construction Co., Los Angeles, for two additions to the local plant, 100x340 and 90x240 ft., for by-products production.

* * *

The Lehigh Portland Cement Co., Allentown, Pa., is perfecting plans for a branch plant at Tarrant City, near Birmingham, Ala., to cost about \$3,000,000, including machinery. The initial works will have an annual capacity of about 1,000,000 bbls. The company has acquired about 250 acres for the new plant.

* * *

The United Filters Corporation, 65 Broadway, N.Y., manufacturer of filtering machinery, has awarded contract to the Campbell Construction Co., Poplar Street, Hazleton, Pa., for extensions to the building recently acquired at that place for its new plant, estimated to cost about \$40,000. E. G. Swetland is general manager.

* * *

The George A. Fuller Co., 1138 Munsey Bldg., Washington, D. C., has the contract for the erection of the new 1-story mill structure, costing \$200,000, for the American Cellulose & Chemical Mfg. Co., at Amelle, near Cumberland, Md. The addition will provide 7,000 sq. yds. additional floor space, will be of terra cotta tile walls, structural steel trusses and gypsum slab roof, and will be equipped to extend the company's activities to the manufacture of the artificial silk filament.

* * *

The General Chemical Company, which has represented for a number of years past the Vulcan Detinning Company in the sale of its anhydrous tetrachloride of tin, will continue to act as its sales agent, not only for anhydrous tetrachloride of tin, but also for caustic soda, tin crystals and bichloride of tin produced during the coming year at this company's plants at Seawaren, N. J., and Neville Island, Pa., the latter having been lately acquired by the Vulcan Detinning Company and theretofore operated by the Republic Chemical Company, Inc.

* * *

The American Malt & Grain Co., 120 Broadway, New York, organized in 1919 to take over the seven malt houses formerly owned by the American Malt Co., at Buffalo, Chicago (2), Milwaukee, Syracuse, Watertown, Wis., and Hamilton, Ohio, in the decision of the directorate of Nov. 18, that the company be forthwith dissolved, has succumbed to the inevitable. The company has outstanding 51,700 shares of no par value stock. It has cash resources of \$1,000,000 after deduction of all outstanding liabilities. It has outstanding \$250,000 in bonds against five plants.

The International Aluminum Co., Detroit, Mich., recently organized, is planning for the construction of a reduction plant on kaolin property recently acquired in Sumter County, Ga., consisting of about 800 acres of land. Headquarters will be maintained at Detroit. J. S. Morton, Detroit, is president, and Crawford Wheatley, Americus, Ga., secretary and treasurer.

* * *

In commenting upon the situation, which, for the fiscal year ending Aug. 31, shows a deficit, after taxes and charges, of \$2,392,531, against a surplus of \$1,844,214 for the preceding period in the business of the American Cotton Oil Co., William O. Thompson, president, says:

"For the first five months of the fiscal year the net earnings of the company were the largest in its history. This was much more than offset, however, by a decline during the balance of the year of over \$40 a barrel in the price of cottonseed oil alone, and the price of other oils and fats vital to the company's business declined proportionately. Inventory values were accordingly reduced to a basis consistent with the low prevailing market, since which substantially all of such values have been realized.

"The sales of edible products, in common with the sales of others in the industry, suffered a severe decline in volume, resulting in large operating losses; but the sale of soap products, considering the general business, has been satisfactory, and did not share the conditions prevailing in the edible oil industry.

* * *

The long maturing plans of the Hercules Powder Co. for the absorption of the Aetna Explosives Co. have come to a head in its agreement, Nov. 15, 1920, with J. S. Bache & Co., New York, to collect for sale and delivery to the Hercules Powder Co. not less than 80 per cent. of the outstanding 545,114 shares (no par) of the Aetna Explosives Co.

The Hercules Powder Co. has agreed to pay to the depository for each share of Aetna common stock \$10.32 in cash and \$4 in the now authorized preferred 7 per cent. cumulative stock of Hercules Powder Co. at par.

The agreement provides that for each share of Aetna deposited, \$2.50 in Hercules Powder preferred will be held in escrow subject to order of the U. S. District Court. Certain claims, including one of the U. S. Government, are still pending against the Aetna Co. and the Hercules stock is held to take care of these.

However, there will also be held in escrow to take care of these claims, \$1,000,000 in U. S. bonds of different descriptions and \$250,000 in cash of the Aetna Chemical Co., its subsidiary. The claims must first be satisfied by these items before the Hercules Powder preferred stock can be touched. It is practically certain that the 80 per cent. required to make the offer effective will be deposited.

FOR SALE

FOR SALE—Brand new No. 5 Sweetland Filter Press, never uncased, at \$2,100 f.o.b., Queensboro, Ky. Press manufactured by the United Filters Corporation, has 190 square feet of filtration surface, with 29 twenty-inch copper leaves covered with 200-pound drill cloth. Upper and lower body castings of cast steel; inside of body acidproofed by tannating; all outlets, manifolds and pipes of brass. Total shipping weight, 6,000 pounds. Address: P. O. Box 100, Weehawken, N. J.



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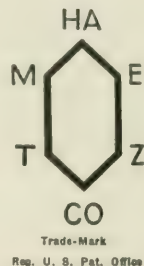
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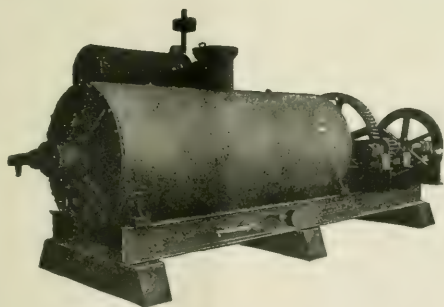
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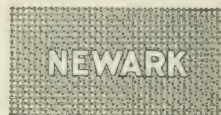
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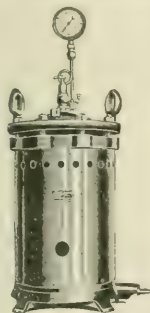


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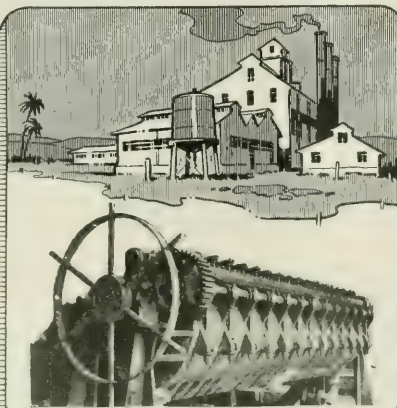
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The ordinary temperature regulator is an uncertain proposition at best. It operates by compressed air, electricity or water. It often contains complex or perishable parts which get "out of whack" or require replacement. You are never sure that it will operate. All uncertainty as to temperature regulation is instantly set at rest with the installation of a

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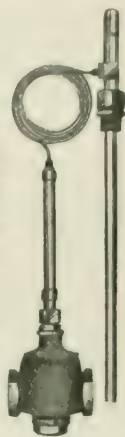
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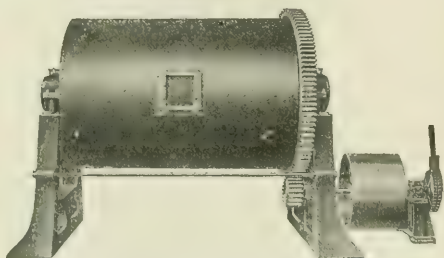
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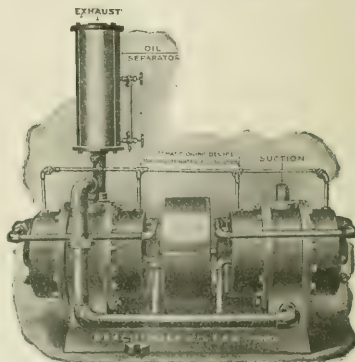
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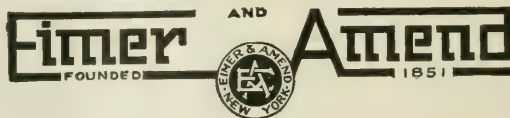
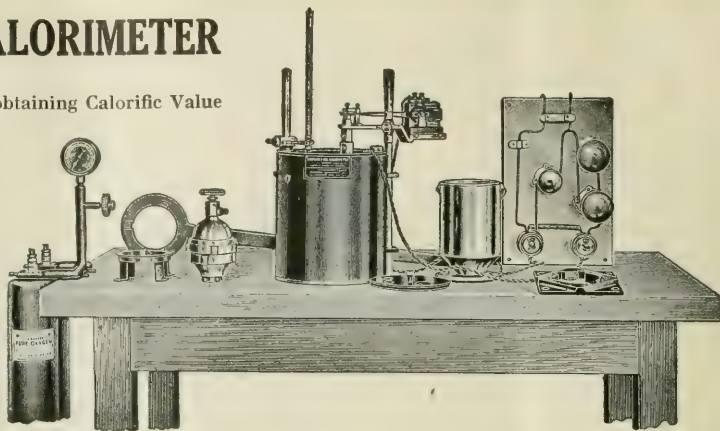
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Of Finest Quality, For Immediate Delivery

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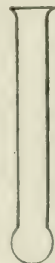
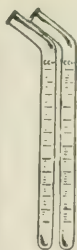
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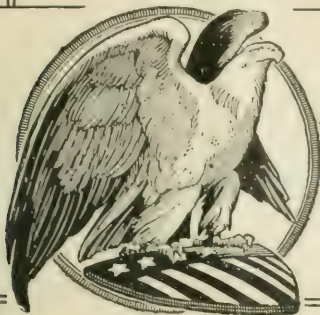
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Tank No.	Total Volume (Pounds)	Sulphuric (Pounds)	Nitric (Pounds)	H ₂ O (Pounds)
1.....	70,000	22,281	45,731	1,988
2.....	72,550	25,697	42,841	4,012
4.....	67,050	20,846	38,051	8,153
5.....	75,050	24,429	39,604	11,017
6.....	78,900	28,372	37,943	12,585
9.....	22,200	7,564	12,925	1,711
10.....	76,800	35,642	17,565	3,502
17.....	74,400	53,404	18,206	2,790
	12,140	8,795	2,791	554
18.....	77,500	48,213	23,405	5,882
22.....	78,850	28,110	41,554	9,186
27.....	71,100	25,966	41,657	3,477
32.....	51,100	51,580	1,415	1,895
33.....	50,350	51,503	559	1,712
36.....	32,550	31,554	684	3

FUMING ACID

Tank No.	Total Volume (Pounds)	Sulphuric (Pounds)	Nitric (Pounds)	H ₂ O (Pounds)
7.....	72,300	73,095	1,909	2,704
42.....	148,030	152,989	2,383	7,342

SULPHURIC ACID

Tank No.	Total Volume (Pounds)	Sulphuric (Pounds)	H ₂ O (Pounds)
12.....	86,423	80,539	5,885
13.....	81,765	76,197	5,568
14.....	83,500	78,665	4,835
23.....	95,350	88,719	6,631
24.....	89,800	82,814	6,986
26.....	91,900	85,614	6,286
28.....	93,350	84,622	8,728
30.....	100,400	93,012	7,388
31.....	17,650	91,149	6,501
37.....	50,700	47,034	3,666
38.....	55,500	51,487	4,013
43.....	171,200	158,777	12,423

All acid located at Carney's Point, N. J.

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15,000 lbs. Location: Carney's Point, N. J.

Lot 2780—2,625 lbs. PHOSPHORUS (in pellets).

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